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REFERENCE GUIDE TO SOCIAL AND ECONOMIC TECHNIQUES

FIRST EDITION
MARCH 1982

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Reference Guide to Social and Economic Techniques

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Introduction

The purpose of the Reference Guide to Social and Economic Techniques is to provide BLM social scientists and managers with current information on social science methods and models that could help them perform analyses required for resource management planning and NEPA work. The Guide is intended to be a "living document," to be kept in a ring binder and added to or subtracted from as new approaches become available and old ones become obsolete. This is your Guide. Much of the content of the first edition was prepared by BLM social scientists in the field. We invite you to suggest revisions, additions, or deletions to this material, based on your experience, now or at any time in the future.

The Reference Guide is not guidance as such, but a kind of mini-encyclopedia describing approaches and techniques for you to choose from in doing your work. It may be that on occasion none of the approaches described here will suit your task. In that case, you are invited to contact the Office of Planning and Environmental Coordination and we will try to help you solve your problem. Any such new solutions would then be candidates for inclusion in the Guide.

Each entry in the Guide includes a general description of the approach, a brief discussion of its strengths and limitations, data requirements, accessibility, applicability to BLM tasks, examples of how or where the technique has been used, and a source or contact for materials and information.

There are two main sections, one for social analysis approaches, one for economic. The first edition contains more economic approaches than social, which we perceive as a reflection on the relative maturity of the two disciplines in the natural resource management context, but we anticipate continuing improvement in the balance of the Guide. A major forthcoming addition to the arsenal of social analysis approaches will be the Guide to Social Assessment sponsored by BLM's Division of Coal, Tar Sands and Oil Shale, to be available in the summer of 1982. An entry for the Reference Guide describing the Guide to Social Assessment will be distributed with that Guide.

We want to thank the contributors to this volume: Roy Allen (Wyoming SO), who edited and wrote a considerable portion of the economic section, Paul Card (Idaho SO), social section editor, Darrell Adams (Bureau of Reclamation), Rich Bernknopfs (USGS), Ken Reinfeld (PPA), Paul Myers (DSC), Sue Richardson (California SO), Loren Cabe (Montana SO), Roy Edmunds (Richfield, Utah CO), Stan Frazier (Idaho SO), Steve Moore (Grand Junction, Colorado CO), Mike Garratt (DSC), John Wong (DSC), and Fred Martinson (DSC). We would also like to acknowledge the efforts of Rich Aiken and Ed Parsons, whose organization of the Reference Guide effort in the Office of Policy Analysis shaped the product we have today.

David Williams
Julia Jordan
Molly Brady

March, 1982

Introduction to the Social Analysis Section

This section of the Reference Guide summarizes several approaches to social assessment that are used by other agencies. There are some similarities between approaches; however, the scope and magnitude is different. Each should be reviewed for applicability to individual situations and full description obtained before decisions are made in terms of whether to use a specific approach. The complexity of the approach used should depend on the size and complexity of the proposed action. No matter which approach is chosen, whether it is one described here or some other, it must be technically correct and generally acceptable to non-Bureau social scientists.

There are several things to consider in choosing the appropriate approach which include: the accessibility of the approach; the cost--both in dollars and workmonths; the ease of using an approach; whether sufficient data would be generated to respond to land management questions; reliability; ease of identifying trade-offs associated with alternative land management actions; necessity for OMB clearance.

It is important to recognize that this group of approaches is by no means exhaustive. There are doubtless many others available that could be useful. If you know of any please submit them to the editors so that they can be added to the Reference Guide.

Name: U.S. Department of the Interior, Bureau of Reclamation, Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account

Description:

General

This manual, prepared by Abt Associates and published in 1975, was designed to guide water resource planners in assessing the social effects of water development alternatives. It is the Bureau of Reclamation's response to the Water Resource Council's requirements for agency implementation of the Principles and Standards for Multi-Objective Planning. Its use is required in the Bureau of Reclamation.

While SAM is closely tied to the Principles and Standards and to water development proposals, it is also appropriate for NEPA compliance. The procedures are applicable to non-water proposals as well. The manual is designed for application at a series of planning specificity levels (from initial Appraisals through Definite Plan reports). The assumptions (e.g., the social assessment is part of a multi-disciplinary effort, limited agency resources, applicability to a variety of proposals, ...) are the same as those faced by BLM social scientists.

The document is composed of three sections:

1. Orientation to the Social Assessment (background concepts).

2. Preparation of the Social Assessment (operationalizing the procedures).

3. Tables to Use in Preparing the SWB Account (items in evaluation categories, measures of impact, magnitude/direction of effects, summary forms for comparisons across alternatives).

The heart of SAM is the second section, Instructions for the Preparation of the Social Assessment. Figure 13 (attached) displays the overall sequence of doing a social assessment. Detailed description of this process model occupies the remainder of the section.

For purposes of illustration, Figure 16 is attached. It presents a format for the presentation of data as part of building a social profile of an area potentially affected by development. This is a fundamental step in the assessment process.

The next attachment, Table 1, is drawn from the SAM section entitled "Tables to be Used in Preparing the SWB Account." This design permits the tabulation of impacts and the valuation of effects. This assessment is completed for each alternative and the factors are categorized under the clusters of (1) Individual Effects, (2) Community Effects, (3) Area Socio-Economic Effects, (4) National Emergency Preparedness Effects, and (5) Aggregate Social Effects. The unit of analysis is thus explicit.

The final step (Table 2 attached) involves examination of effects across alternatives, in contrast to the previous focus on individual alternatives. The use of Table 2 allows the documentation of a recommendation, the final step of the overall process.

Strengths

The Social Assessment Manual is very thorough and systematic. The logic behind the procedures is clearly presented. The approach is widely recognized in the social assessment community. In examining several alternatives, the user is assisted in evaluating effects at different sites, through different time horizons, and by direct and indirect means of causality.

By design, SAM was written for persons lacking advanced technical training and social assessment experience. This is an asset since the analytical results should be credible to both technical and non-technical persons.

Limitations

While SAM was designed to apply toward projects and alternatives of varying scale, it is, in fact, most appropriate for large-scale construction projects. This is largely due to lack of guidance (decision rules) on scaling the analysis relative to the proposals and lack of linkage to economic-demographic projections.

Guidance on projecting effects is quite limited. This is characteristic of the discipline as a whole, however, and SAM should not be severely faulted for this reason.

The flip side of SAM's thoroughness is its detail. A solid investment of time is required to fully appreciate the logic and understand the procedures. It was not prepared for the casual user.

A final, though minor, problem is the utility of selected evaluation items. According to a Bureau of Reclamation source, several of the many items have proven not to be worthwhile in evaluating projects.

Data Requirements:

Secondary and primary.

Accessibility:

The Social Assessment Manual is available from the following sources:

1. National Technical Information Service
2. Westview Press, Boulder, Colorado

Applicability:

SAM would be most directly appropriate for planning in which the alternatives have distinctly different implications for local social conditions. Situations involving relatively high levels of migration, population change, and similar effects are included. The lack of guidance (decision rules) on tailoring the analysis to the scale of the project(s) has resulted, in the Bureau of Reclamation, in some elaborate work being done without justification.

Where-How approach has been used:

Technical Appendix, Social Assessment, Feasibility Report: Zuni Project
Technical Appendix, Social Assessment, Planning Report: Animas - LaPlata Project
Techical Appendix, Economic-Demographic-Social Assessment: Feasibility Report, Lower James - Fort Randall Project

Source/Contact:

Darrell Adams
Division of Planning Technical Services (D-733)
USDI Bureau of Reclamation
Denver, Colorado 80225
FTS 234-4128

Figure 13. A Schematic Presentation of the Social Well-Being Account Preparation Process

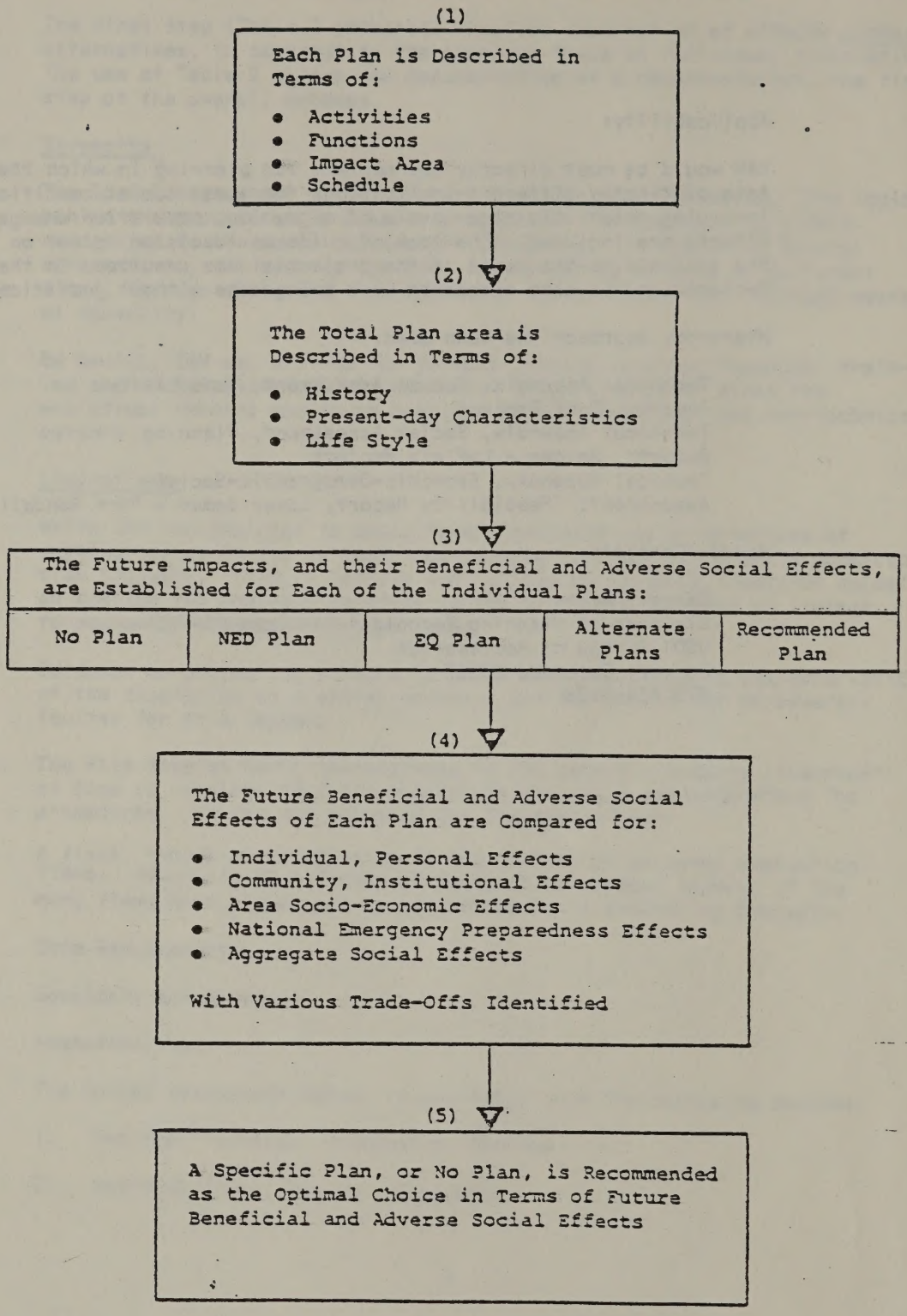
(1)
Each Plan is Described in Terms of:
• Activities
• Functions
• Impact Area
• Schedule
(2)
The Total Plan area is Described in Terms of:
• History
• Present-day Characteristics
• Life Style
(3)
The Future Impacts, and their Beneficial and Adverse Social Effects, are Established for Each of the Individual Plans:
No Plan
NED Plan
EQ Plan
Alternate Plans
Recommended Plan
(4)
The Future Beneficial and Adverse Social Effects of Each Plan are Compared for:
• Individual, Personal Effects
• Community, Institutional Effects
• Area Socio-Economic Effects
• National Emergency Preparedness Effects
• Aggregate Social Effects
With Various Trade-Offs Identified
(5)
A Specific Plan, or No Plan, is Recommended as the Optimal Choice in Terms of Future Beneficial and Adverse Social Effects

Figure 16. A Hypothetical Social Profile

Topics and Items	Measure		Rating AA/A/B
	Planning Area	Regional or National Norm	
EDUCATION			
Average Education Level for Adults 25 Years or More			
% High School Dropout Rate			
% H.S. Seniors Going to College			
Average H.S. Senior Achievement Test Performance			
WELFARE			
% Population Receiving Welfare Payments			
% Population Receiving Welfare Services			
GOVERNMENT			
Local Gov't. Employees Per Capita			
Total Gov't. Budget			
% Adult Population Registered Voters			
LAW AND JUSTICE			
No. Rpt. Victims of Crime per 1,000			
Per Capita Loss Due to Crime			
No. Police Officers per 1,000 Persons			
HEALTH			
No. Deaths per 1,000 Live Births			
Average Age of Death			
Number Reported Cases per 1,000 Streptococcal Sore Throat and Scarlet Fever			
No. Doctors per 10,000			
SOCIAL SERVICES			
No. Divorcees per 1,000			
No. Children in Adoption Homes per 1,000			
No. Juvenile Arrests per 1,000			
No. Trained Mental Health Professionals per 10,000			

Table 1. Beneficial and Adverse Effects on Social Well-Being Under the Plan for

Items in Evaluation Categories	Measures of Impact	Effects ++,+,0,-,--
II. COMMUNITY, INSTITUTIONAL EFFECTS		
A. DEMOGRAPHICS		
1. Changes in general demographic makeup of the population		
a. Size		
b. Density		
c. Migration trends		
d. Age/sex distribution		
e. Marital status		
f. Ethnic groups		
2. Secondary effects related to changes in general demographic makeup of the populations (if not discussed under another category)		
3. Other changes (specify)		
B. EDUCATION		
Change in State Variables		
1. Size of enrollment in schools		
2. Type of enrollment in schools, by age, income, ethnic group, etc.		
3. Level of education of general population		
4. School dropout rates		
Change in Relevant Condition Variables		
5. Birth rates in area		
6. Percent of population of school age		
7. Number of persons 25 and over with four years of high school or more		

Table 2. A Summary Comparison of the Beneficial and Adverse Effects of the Alternative Plans for the Social Well-Being Account

Items in Evaluation Categories	Present Conditions	Beneficial & Adverse Effects of Plan					
		No Plan	NED Plan	EQ Plan	ALT "X"	ALT "Y"	RECC Plan
II. COMMUNITY, INSTITUTIONAL EFFECTS							
A. DEMOGRAPHICS							
1. Changes in general demographic makeup of the population							
a. Size							
b. Density							
c. Migration trends							
d. Age/sex distribution							
e. Marital status							
f. Ethnic groups							
2. Secondary effects related to changes in general demographic makeup of the populations (if not discussed under another category)							
3. Other changes (specify)							
B. EDUCATION							
Change in State Variables							
1. Size of enrollment in schools							
2. Type of enrollment in schools, by age, income, ethnic group, etc.							
3. Level of education of general population							
4. School dropout rates							
Change in Relevant Condition Variables							
5. Birth rates in area							
6. Percent of population of school age							
7. Number of persons 25 and over with four years of high school or more							

*Conditions (Above to below Average: AA,A,BA); Effects (Beneficial to Adverse: ++,+,o,-,--).

Name: Other Social Effects (OSE) Account of the Water Resource Council's Principles and Standards for Planning Water and Related Land Resources

Description:

General

The OSE Account is the social account portion of the Principles and Standards (P&S). The P&S provide planning guidance to the Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, Tennessee Valley Authority, and other agencies involved in federal water resources planning. The 1980 (18 CFR Part 711) version reflects the first major revision of the P&S since they were originally approved by the President in 1973. However, new federal water planning guidelines are now being prepared to replace the 1980 P&S. At present, it appears that only modest changes are contemplated for the content of the social account portion of the new planning guidelines.

The OSE account is one of the four accounts of the P&S. The other three are: (1) the National Economic Development account, (2) the Environmental Quality account, and (3) the Regional Economic Development account. Use of all four accounts is required in the 1980 P&S. It is possible that only the National Economic Development account will be required with the new planning guidelines.

Figure 1 shows the categories of social effects which were to be analyzed in the 1973 and 1980 P&S social accounts, along with those proposed for the 1981 planning guidelines. All of the approaches lack conceptual coherence, and something of a "grab bag" approach to conceptualizing social consequences is evident to the experienced social analyst. However, the concepts are abstract, allowing some freedom in interpretation. This feature is important in that agencies with different planning needs are to use the guidelines.

The post-1973 approaches draw a distinction between "assessment" (impact measurement) and "appraisal" (assigning social values to the technical information gathered as part of the assessment process). Multiple points-of-view regarding the social meaning of a given impact are recognized and permitted under the accounting system. Impacts are the difference between future without (no action) conditions and future with each plan. Tradeoffs are to be analyzed on the basis of incremental differences between the future with and without conditions across plans. Integration of P&S requirements and National Environmental Policy Act (NEPA) requirements are emphasized in the post-1973 versions.

Strengths

Social assessment procedures are but a portion of the overall water resources planning process. The procedures are fundamentally as sound as those of the broader planning process and they are placed in a context of public involvement in the planning process. The fundamental idea of an account, with its notion of a "bottom-line" of net social effects has encouraged development of improved measurement procedures in the social assessment area.

Figure 1

1973 P&S	1980 P&S	1981 Planning Guidelines (draft only)
Account: Social Well-Being	Account: Other Social Effects	Account: Other Social Effects
Components:	Components:	Components:
a. Real income distribution	a. Urban and community impacts	a. Urban and community impacts
b. Life, health, and safety	1. Income	1. Income distribution
c. Educational, cultural and recreational opportunities	2. Employment	2. Employment distribution
d. Emergency preparedness	3. Population size and composition	3. Population distribution and composition
e. Other	4. Fiscal condition of the State and local governments	4. Fiscal condition of the State and local governments
	5. Quality of urban and community life	5. Quality of community life
	b. Life, health, and safety	b. Life, health and safety
	c. Energy requirements and conservation	c. Displacement
		d. Long-term productivity

Limitations

Absence of conceptual elaboration fails to provide clear guidance for practioners new to the field or for the public. However, this limitation is not serious given the flexibility it offers to agencies having very different planning needs and requirements.

Potentially troublesome is the proposed approach of the new planning guidelines which would make use of the social account optional rather than mandatory for the agencies. The purpose of the optional approach is to streamline the planning process. It may have the effect of providing license to those who would ignore important social consequences of water resource development.

Data requirements:

To be determined by each agency - probably both primary and secondary data.

Accessibility:

The 1973 P&S were published in the Federal Register (September 10, 1973, FR 24778 - 24862). The 1980 P&S were published in the Federal Register (September 29, 1980, FR 64366 - 64400).

Applicability:

Applicable in situations where multiple-objectives are considered (as contrasted with single-purpose planning). Most appropriate where plans would involve important social changes associated with in-migration for construction or relocation of current residents.

Where - how approach has been used:

Corps of Engineers - planning reports.
Bureau of Reclamation - planning reports, technical appendices.
Soil Conservation Service - planning reports.

Source/Contact:

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Denver, CO 80225
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Name: Foundation for Urban and Neighborhood Development (FUND): Social Resource Management; Social Analysis Procedures for Land Management and Planning

Description:

General

FUND has developed two related but distinct approaches under the name, Social Resource Management. One is a management information system or public involvement approach for assuring that natural resource managers are aware of and responsive to public concerns. The other is an approach to social impact assessment that is an outgrowth of the FUND management philosophy.

The FUND approach was developed primarily under contract with the U.S. Forest Service, which altered its name from Social Resource Management (SRM) to Socially Responsive Management (SRM). This reflects a concern, with which BLM employees will be familiar, about appearing to be managing the social environment, which is seen to lie beyond the authority of Federal natural resource management agencies. On the other hand, there is general acknowledgement that we must be aware of and responsive to the interests of people who care about and/or are affected by natural resource management decisions. The FUND materials attempt to maintain the delicate balance between these two considerations.

Written materials produced by FUND include four handbooks, several papers, and several social analysis reports (see listing at end of this section). The handbooks are intended to supplement training courses conducted by FUND, and are thus insufficient guidance for fully understanding and/or implementing the approach. However, they do contain enough information to form a general impression of the FUND techniques.

The first three handbooks outline SRM, a "management tool" (as opposed to an impact assessment tool) for systematically learning, recording, and taking into account the concerns of people affected by management decisions. SRM teaches managers to get themselves and their staffs involved in public input activities that go beyond standard public participation techniques such as public meetings. They are encouraged to seek out and analyze contacts with representatives of "networks" in the local area to learn what issues concern them. These contacts may involve more systematic attention to information that arises out of agency personnel's personal lives (e.g., if they belong to organizations that represent "publics" affected by management decisions) or a new sense of legitimacy in using working hours for focused socializing (e.g., taking a regular coffee break at the cafe where the ranchers gather). Such contacts are intended to allow the manager to monitor people's resource use activities and attitudes, events in the social environment that influence program management, and social and economic trends that affect resource demands.

The FUND framework for organizing and analysing the information gained in this way includes:

- Seven social-cultural descriptors which, in combination, are intended to qualitatively characterize the

- Human Resource Unit (HRU), a geographical area that doesn't necessarily correspond to agency or other jurisdictional boundaries, but delineates an area of related social activities, by tapping into

- Networks of people who represent affected publics.

The seven social-cultural descriptors (Settlement Patterns, Publics, Networks, Work Routines, Supporting Services, Recreational Activities, and Geographic Boundaries) are equivalent to the variables for consideration in social analysis. For example, if sliced another way they would essentially cover the four categories of variables listed in the Forest Service Manual (1973.3) for Social Impact Analysis (Lifestyles; Attitudes, Beliefs, and Values; Social Organization; and Population and Land Use).

The Human Resource Unit is the basic local unit of analysis, one of three "Social Analysis Units." Social Resource Units are regional in scope, Cultural Resource Units are national. An HRU is similar to BLM's old SEPA (Social-Economic Profile Area).

Network identification is essentially a methodology for selecting respondents, equivalent to identifying key informants. Networks are represented by respected "contacts" who are encountered wherever network members commonly gather.

The handbooks contain forms for organizing the information acquired from network contacts and for deriving the management actions appropriate for responding to both "public issues" and "management concerns." They also contain analytical questions to be asked in characterizing the HRU and defining issues.

The fourth handbook, "Social Analysis Procedures for Land Management and Planning," addresses FUND's approach to Social Impact Assessment (SIA). It should be noted that in earlier editions of the first three handbooks, FUND asserted that SRM could meet requirements for SIA in addition to enhancing the social responsiveness of management decisions. This claim met resistance from Forest Service social scientists on the grounds that while SRM is basically a useful public involvement mechanism it nevertheless fails to indicate social impacts that may not be perceived in advance by network contacts. FUND now agrees with this distinction, and Handbook 4, published in second draft November 1981, attempts to tie SRM concepts (e.g., the seven social-cultural descriptors) to established SIA thought processes, particularly FSM 1973.

Handbook 4 focuses on ongoing resource management planning, although the social analysis variables and approaches could be adapted to analyzing non-agency initiatives. It places strong emphasis on delineating "social assessment areas," or areas of expected impact, as units of analysis. Although no explicit discussion links social assessment areas to HRUs or other "social analysis units," the concept is similar.

One product of the analysis would be a "social overview," a Forest Service document similar to BLM's Planning Area Analysis (FSM 1973.51). There is ambiguity about the role of the social overview, originating in FSM 1973 and reflected in FUND's Handbook 4. Forest Service social scientists indicate that preparation and updating of overviews depends on perceived need, and have not been seen as a standard requirement. Criteria for determining the need for an overview or update are not stated in either FSM 1973 or Handbook 4.

Procedures are also described that would result in analysis suitable for inclusion in EAs or EISs associated with planning, and analytical questions are provided to help assess social implications of each management program (timber, range, recreation, wildlife, wilderness, water, minerals, protection, lands/soils/facilities, human and community development). See the attached Table of Contents for the organization of the Handbook.

It is assumed that the bulk of the work in SRM and FUND's SIA approach would be performed by field managers and resource staff. The assumption that sociologists would serve as supervisors or consultants on social analysis efforts acknowledges the scarcity of sociologists in natural resource management agencies. An approach often used in BLM, bringing in a sociologist from the State Office or Service Center to perform SIAs, would be discouraged by the FUND approach, which stresses the importance of the analyst's residence in the impact area. Training and handbooks are both directed to a non-sociologist audience.

Strengths

- Strong orientation to management information needs for decisionmaking.
- Emphasis on agency responsiveness to public concerns.
- Jargon-free writing.
- Involvement of managers and resource staff in social awareness activities.
- Possibility for utilization by non-social scientists for SIA.
- Recognition of the importance of qualitative information for interpreting the meaning of quantitative social indicators.
- Analytical questions relating social effects to individual resource management programs.

Limitations

- SRM assumes time-consuming management and resource specialist participation: gathering information and keeping records of contacts.
- Approach is not completely accessible through handbooks but requires training for full comprehension. Training is fairly expensive ($7500 for courses I through III), and Forest Service contacts give mixed reviews of the courses. Training on the current draft of Handbook 4 has not yet occurred, so is untested. FUND tends to be fairly uncommunicative about the details of training, to protect the approach from competitors. They acknowledge that this policy asks agencies to buy somewhat of a "pig in a poke."

- Handbook 4, in its effort to wed SRM and the Forest Service manual, is somewhat ambivalent. The SRM variables (descriptors) and the FSM 1973 variables are not fundamentally different in content, taken together. But the social scientist or resource specialist responsible for SIA would find it confusing to sort out the way the Handbook tries to incorporate both sets and add some other (overlapping) SIA indicators such as population size, employment mix, wage structure, poverty level, and land use patterns.

- Some important SIA concepts, such as social organization and social well-being, are not systematically addressed in Handbook 4 (compare forthcoming Social Assessment Guide by BLM).

- The data gathering methods and analysis techniques are not sufficiently described to be fully evaluated, but it may be inferred that some publics would be underrepresented by network sampling and others overrepresented.

- There is a strong local bias in the approach that could allow significant effects to the larger society to be ignored.

- The focus on variables that "best describe existing social characteristics and trends in the local area" fails to scope and aim SIA at probable significant impacts from a given proposal. There is a danger of over-attention to descriptions of the existing environment.

Data Requirements

Primary and Secondary.

Accessibility

Foundation for Urban and Neighborhood Development
2653 West 32nd Avenue
Denver, Colorado 80211
(303) 433-7163

Applicability

SRM or an adaptation of it may have real utility as a management tool for BLM field officials. That FUND is the best source of guidance and training is not a foregone conclusion. There is presently consideration of a BLM test of an SRM-style approach, and it is anticipated that a competitive RFP would elicit offerings from other contractors who could conceivably have more attractive proposals. Handbook 4, the SIA approach of FUND, is compatible with SRM, but is not a necessary companion to it. The approach is designed for a resource agency similar to BLM, but it is of unproven effectiveness in the agency context. SIAs using this approach have been performed by FUND under contract to the Forest Service, but not by Forest Service personnel. The SIA approach may have applicability to social assessments performed as part of RMP EISs or MFP Amendments. It seems less appropriate for major actions such as energy development projects, which may require more sophisticated SIA techniques.

Where/How Approach Has Been Used

SRM has been applied by the Forest Service in Regions 2, 4, and 9. Region 2 has a particularly strong commitment to this method of public involvement.

The SIA approach was used in the Social Impact Assessment for the Adam's Rib Recreational Area (Region 2, USFS), April 1981 by FUND.

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Documents Available from FUND

Social Resource Management Handbooks

1. An Introduction to Social Resource Management, Course One Training Workbook, December 1980.

2. Procedures for Characterizing and Delineating a Human Resource Unit Using Cultural Descriptors, December 1980.

3. Procedures for Identifying and Evaluating Public Issues, Management Concerns and Management Opportunities, December 1980.

4. Social Analysis Procedures for Land Management and Planning, November 1981 (Draft).

Example: Social Resource Unit Q, May 1980

Example: Adam's Rib SIA, April 1981.

Papers: "The Issue-Centered Approach to Social Impacts: From Assessment to Management," by Kevin Preister and James Kent, December 1981.

"Issue Management for Natural Resource Professionals," by Richard J. Greiwe, November 1981.

"A Social Analysis Approach for Forest Planning," by Richard J. Greiwe, June 15, 1981 (Draft).

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Chapter Two emphasizes the application of social analysis as a process for understanding and resolving the significant issues facing an organization. The use of social assessment areas as a context for developing future management programs and practices is discussed. The active participation of local field staff in collecting and analyzing social data is also promoted.

3.0. PROCEDURES FOR DESCRIBING CURRENT SOCIAL CONDITIONS.....	4

Chapter Three outlines a step-by-step process local field staff can use to collect and record information on the social environment in which they administer resource programs. Ways to use this descriptive data to delineate social assessment areas and determine relevant social variables for social analysis purposes are covered.

4.0. PROCEDURES FOR PROJECTED FUTURE SOCIAL TRENDS.....	12

Chapter Four presents procedures for projecting major social trends into the future. Social variables that indicate the rate and type of change, and describe how the change will alter current social conditions are included. A process for reaching agreement on the projected social trends in an area is also discussed.

5.0. PROCEDURES FOR RESPONDING TO CHANGING INFLUENCES ON RESOURCE MANAGEMENT.....	28

Chapter Five uses the projected social trends to determine the adjustments needed in current management direction. Specific procedures are outlined for evaluating potential impacts on future resource programs and practices. Management actions are then developed to respond to these anticipated social conditions as a part of the resource planning process.

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6.0. PROCEDURES FOR ESTIMATING SOCIAL IMPACTS OF PROPOSED MANAGEMENT ACTIONS..... 39

Chapter Six provides procedures for estimating social impacts of resource planning alternatives. Social variables that measure the beneficial and adverse effects of proposed actions on people and their social environment are outlined. Ways to manage the adverse impacts of resource planning in cooperation with other organizations are also discussed.

7.0. CONCLUSION..... 48

Chapter Seven points out that social analysis is used to monitor the implementation of a resource plan. It advocates evaluating the effectiveness of actions taken over time to achieve desired social conditions and resolve significant public issues. The function of local field staff in monitoring changing social conditions in an ongoing manner is also explained.

Name Social Impact Assessment for Forest Planning and Decisionmaking. Technical Review Draft. USDA Forest Service, Region 1, Missoula, Montana. June 1980. Palmer Bowen, et al.

Description

General

The report describes Forest Service Region 1 approach to social assessment and analysis. The system focuses on six components of social impact assessment to be used in forest planning:

- Social Units - identifying the public in terms of social groups.
- Zones of influence - determining where affected people live.
- Social issues - examining the points of conflict stemming from differences in values, attitudes, and perceptions within a community.
- Social variables - selecting the aspects of a community that can be measured and may be potentially affected by agency actions: what will change in the lives of people as a result of agency actions. The variables suggested include: sense of control/self-sufficiency, certainty/uncertainty, symbolic meaning, lifestyle and job dependence, emotional/spiritual renewal, community cohesion, population change and crowding, and land ownership patterns.
- Present conditions - determining what lifestyles are like now and how they are changing.
- Anticipated social changes and their effects - projecting how people will be affected by agency actions.

The Region 1 approach structures the components of social impact assessment into two parts: social assessment and social analysis. Social assessment aims at assessing the present social conditions and trends to set the stage for social analysis. The assessment process includes the following steps: getting a feel of the area; capturing known social data; identifying the people who are affected; determining the zones of influence; selecting the variables; establishing the baseline condition; assigning numbers to baseline data; and reality checking the information. Social analysis consists of gathering information on the effects of proposed land management alternatives and predicting changes that would take place with each alternative. The steps in social analysis are similar to those of social assessment except that the analysis is made for each alternative rather than for an extension of current conditions. The techniques emphasized to accomplish social impact assessment are participant observation, demographic analysis, and a surrogate survey (using agency personnel to obtain the numbers for the data).

The integration of social impact assessment into the Forest Service planning process is addressed for each of the ten steps:

- Identifying Issues. With the I.D. team, the social scientist helps identify and and interprat issues that are gathered through public involvement. The product is a narrative description which conveys local sentiments and concerns. Focuses on issues as they directly affect, or are affected by social units in the Forest Zone of influence.

- Planning Criteria. The I.D. team and social scientist designate the social factors to be included in the assessment and analysis (process criteria) and specify the set of social conditions (developed within social, biological, and physical constraints) that compose a desired way of life (decision criteria).

- Inventory Data and Information Collection. Social data is presented and integrated with other data and related to pertinent geographic locations and demographic conditions. A narrative description reveals the pertinent social characteristics and relevance to the Forest Plan.

- Analysis of the Management Situation. This baseline data includes (1) a narrative description of the communities and people affected by Forest actions, (2) a scenario of what will happen in the future if present conditions continue, and (3) a map of the geographic zones of influence illustrating the location of the potential social effects.

- Formulation, Estimated Effects, and Evaluation of Alternatives. The information from previous steps is used to formulate alternatives and project their effects. The description of the desired condition of the social variables is one of the planning criteria used for alternative evaluation.

- Selection of Alternatives, Plan Implementation, and Monitoring. Social data needs to be verified by public comments during the review period of the plan. The social scientist needs to check that social changes are occurring as predicted during the life of the plan, and the usefulness and significance of variables and research techniques used must be monitored.

Figure 2 summarizes the interrelationships.

Strengths

The approach is comprehensive and systematic, addressing all primary aspects of social impact assessment in forest planning. The assumptions and philosophy upon which the method is based are described. Appendices are included with a great deal of supplementary information on concepts, definitions, and methodology. The terminology used is clear, not jargon-laden.

Limitations

The suggested approach to quantification through assigning numbers to social data is a move in a commendable direction. The method described, however, and the integration of the resulting information are weak. The use of a surrogate survey may produce interesting results and useful insights, but any generalization or translation of these to the "real world" would be questionable, especially on the basis for any sort of rigorous analysis.

Data Requirements

A wide variety of data types can be used in this approach - from demographic analysis to structured interviews. Information on and discussion of a dozen different gathering methods are presented in the appendices.

Accessibility

Unlimited.

Applicability

The approach described and concepts used are similar to and compatible with these procedures: most aspects would be directly applicable to any Resource Management Plan process in the Bureau.

Examples of Use

Unknown.

Source/Contacts

Don Holden
U.S. Forest Service
P.O. Box 7669
Missoula, MT 59807
406-585-3392/406-329-3392

FIGURE 2.--RELATIONSHIP OF PLANNING ELEMENTS AND SIA STEPS

NFMA Planning Process	*Social Impact Assessment Process as Related to NFMA Planning Process		SIA as Related to Forest Plan - In Practice
	Social Assessment	Social Analysis	
1. Identification of Issues, Concerns, & Opportunities.	Getting a feel of the area. Zone(s) of Influence. (Capturing) Known social data. The people who are affected (& how). } Preliminary		Narrative description that focuses on issues as they directly affect communities (on site) near the NF.
2. Planning Criteria.	Selecting social variables (sensitivity). Reality checking.		Social criteria - social variable identification. Description of most desirable social situation.
3. Inventory Data and Information Collection.	Getting a feel of the area. Capturing known social data. The people who are affected. Determining the Zone(s) of Influence. Reality checking. } In Detail		Narrative description of lifestyles & geographic & demographic areas of present effects. Map of zones of influence and concern.
4. Analysis of the Management Situation.	Baseline Data -- Present conditions, with future projections. Putting numbers on the Baseline Data.		Narrative description of communities and present affects. Predicting future social effects -- no action alternative. Preliminary quantification.
5. Formulation of Alternatives.	Baseline Data -- Present Conditions.	Reassessing the area. (Capturing) Known social data on the effects of alternatives. Reality checking.	Present condition with projections of dependence and effects. Formulation of socially oriented alternatives.
6. Estimated Effects of Alternatives. 7. Evaluation of Alternatives. 8. Selection of Alternative.		(Capturing) Known social data on the Effects of Alternatives. How the people are affected by the alternatives. Zone(s) of Influence. Changes in the Variables. Baseline Data -- social effects. Putting numbers on the Social Analysis. Reality Checking	Narratively determine social effects of alternatives. Quantify as appropriate. Comparison of social costs and benefits. Mitigation measures. Field checking for accuracy, usefulness. Reassess and/or modify alternative.
9. Plan Implementation.		Baseline Data -- Social Effects. Reality checking.	Mitigation of predicted social change. Checking expected changes for affect.
10. Monitoring and Evaluation.		Monitoring (Incorporates Reality Checking).	Accuracy of data, methods, & predictions. Constructing new models.

* In content, not necessarily in time.

Estimation of Social Effects: Social Science in the Planning Process

October 15, 1980; Dr. Arnold Holden, USDA Forest Service, Region 6, P.O. Box 3623, Portland, Oregon 97208 (FTS 423-3589/ Commercial 503-221-3589)

Description

General

This paper discusses and describes how social science input to the Forest Service planning process should be handled. It details products to be shared for use by the interdisciplinary team, as well as suggesting the inputs and interaction for the social scientist at each step of the process.

The Socio-Economic Overview (SEO) is the primary product for the social sicentist in the process. It forms the basic description of current conditions, as well as of baseline conditions. The SEO should serve two crucial functions: (1) to distill all the available sociological and general economic data into that which is relevant to management, and (2) to interpret, organize, and incorporate those data into a readable comprehensive picture of a socioeconomic setting of the area and the issues and concerns. In terms of content and organization, the SEO should:

- Address and interpret the social and economic basis of the issues, Concerns, and Opportunities (but not be specifically organized around issues and concerns).
- Present a description of current social and economic conditions, and a brief history of the area.
- Project trends and expected uses and needs 20 years into the future, and consider trends over the last 20 years as a background to current and future conditions.
- Focus on the entire Zone of Influence of the Forest, and note how it compares to State or Regional trends and conditions.
- Include interpretation of those social and economic variables specified in regulations, manuals, and handbooks, as well as those identified by the social scientist and the interdisciplinary team as relevant to the area and issues and concerns.
- Discuss problems of data reliability, inconsistency, or gaps in relevant information which may affect estimation of effects.

Another product described for use by the team, intended primarily as a supplementary working tool, is the Management and Public Concerns Map (MPC Map). The MPC Map is a means of graphically displaying the trends, concerns, management problems, and the "people conflicts" over resources that might be considered in the plan.

In addition to discussing the formulation and content of the SEO and the MPC Map, the integration and inputs of the social scientist in each of the

ten steps of the planning process is described--from identification of public issues through monitoring and evaluation. The Estimation of Effects of the Alternatives step suggests a structure to give an objective, systematic, comprehensive estimate of the relative importance of all the effects:

- Delineate the Zone of Influence - i.e., the area to be looked at to describe the Forest context and baseline and estimate the effects.

- Select the units of social analysis to be considered for estimating effects.

- Select social, population, and economic variables to describe the current and likely future conditions, and to measure the effects of the alternatives. The suggested list of variables to describe and measure effects of Forest Plan alternatives was (1) population change and crowding, (2) lifestyle and job dependence, (3) beliefs and perceptions, (4) community cohesion, (5) land ownership and use patterns, (6) sense of control/sense of self-sufficiency, (7) certainty/uncertainty. In general, the preferred social effects of proposed alternatives are those which equitably enhance the stability and quality of social life of communities.

- Determine the scope and combinations of prescriptions (outputs and practices) to be considered as causing social effects.

- Display in the most effective way the comparative social effects of the alternatives.

A series of structured worksheets showing in matrix form the effects of each output or practice of an alternative is suggested for display (see Figs. V and VI). Then a summary matrix is prepared for the most significant effects (see Fig. VII) to systematically review the full set of social effects of each alternative, taking into account interactions of effects. Finally, the social effects of each alternative are described in a narrative description (see Fig. VIII).

Strengths

The approach described is systematic, with a practical orientation to "real world" capabilities as well as needs. It is geared toward what management needs rather than what the specialist wants to generate. Concepts and terms are explained in terms understandable to non-social scientists.

Limitations

The focus of the approach is on succinct, relevant qualitative descriptions of social effects. Such a nonquantitative method could be construed as a limitation. Also, the involvement of the social scientist in the earlier steps of the planning process is weak; more active participation should be encouraged at the earliest stages.

FIGURE V

WORKSHEET: Social Effects Alternative: II Outputs and significant practices: Range

25% increase in AUMs over No-Change by 1995, most increase in spring months, some range improvement projects 1982-1987

Limited Effect: Improved economic picture for existing ranching operations

UNITS OF ANALYSIS	VARIABLES			
	Land Ownership and Use Patterns	Population Change and Crowding	Sense of Control/ Sense of Self-Sufficiency	Community Cohesion
County Seats (Government and Service Industries)	No Change	No Change	Better than No Change, as long-time residents are benefited, fewer newcomers	Ranching interests more influential, but no major change
West Side Rural (Forestry and Wood Products)	No Change	No Change	No effect	No effect
East Side Rural (Forestry, Tourism, and Ranching)	Stabilizing * Less conversion of ranch land to recreation, residential, or ranchettes	Less growth than No Change, due to little land available. Current labor force can handle increased ranching activities *	Generally improved, less change than No Change would bring. Current ways of life facilitated, but no growth for tourism/rec/real estate *	Ranching more influential, but at slight expense to tourism & forestry interests Increased conflict (slight)
Southern Valleys (New Rural Lifestyle, Farming, Crafts)	Little Change	No Change	Little effect here, may increase pressure for small rural farms	No Clear Effect

* Major Effects

FIGURE VI

WORKSHEET: Social Effects Alternative: B Outputs and significant practices: TIMBER

10% decline in sales by 1990 (gradual decline), TSI only on most productive sites, Environmental/Political restrictions on several TM practices

Initial Effects: Drop in employment (but mostly by retirement and no new hires) in logging and wood product mills, substantial reduction in woods workers. Increasing cut on Private Land

UNITS OF ANALYSIS	VARIABLES: Land Ownership and Use Patterns	Population Change and Crowding	Sense of Control/ Sense of Self-Sufficiency	Community Cohesion
County Seats (Government and Service Industries)	No effect/change	Slight decline due to drop in wood products. Growth not as rapid as No Change predicts.	No major effect, although effect of employment drop is not helpful	Threatened, particularly with conflict between the economic and environmental proponents *
West Side Rural (Forestry and Wood Products)	Value of forest land increased, private owners doing more TSI	Population decline, mostly through out-migration of young adults.	Reduced - Some decline in cut was expected, but reduction in TSI employment was not, perceived as caused by outsiders *	Threatened, lack of economic growth/activity conflict within over environmental controls on TM *
East Side Rural (Forestry, Tourism, and Ranching)	Increased value of timber also reduces conversion to recreation - clear cuts at low elevation offend tourists.	Less growth than projected	Same as above, also tourism (rec. industry, tourists) don't understand new management of private lands.	Same as above, particularly in forestry related sectors increased cut on private lands conflict with tourism *
Southern Valleys (New Rural Lifestyle, Farming, Crafts)	Little change	Less growth than projected	No effect, or perhaps increased as not as involved in disruption in other areas.	No negative effect

* Major Effects

FIGURE VII

SUMMARY MATRIX: Social Effects

Alternative: D Outputs and significant practices: Timber - 10% reduction in cut, restrictions on TSI activities and practices, Range - 25% increase in AUMs, Recreation - 40% increase in RVD in developed areas, south side, Wildlife - 15% increase in Deer Animal Equivalents

UNITS OF ANALYSIS	VARIABLES: Land Ownership and Use Patterns	Population Change and Crowding	Sense of Control/ Sense of Self-Sufficiency	Community Cohesion
ounty Seats Government and ervice Industries)	No Effect	Effect of Timber and Recreation changes cancel Growth as projected under No Change	Changes in other communities come to county seats for resolution, recognition of importance, power	Changes, conflict over economic growth environmental effects
ast Side Rural Forestry and Wood roducts)	No Major Effect	Slight Decline	Decreased, particularly by reduction in TSI	Conflict over environmental questions
ast Side Rural Forestry, Tourism, and anching)	Less conversion of ranch land	Less growth than projected	Varies throughout community	Various conflicts within the community, but less than No Change would have generated
outhern Valleys New Rural Lifestyle, arming, Cattle)	Increasing price, growth of commercial use, subdivision	Substantial growth associated with recreation development	Present residents greatly threatened, new arrivals feel more self sufficient	Present residents will conflict with new arrivals.

FIGURE VIII

NARRATIVE DESCRIPTION

Social Effects: Alternative B

County Seats This Alternative will have a minor effect on the several county seats. The conflict in the other communities will relayed to the various people and institutions in the county seats for resolution and create conflicts. Conflict over environmental, recreation, and growth issues will be more severe than they would have been under the No-Change Alternative.

West Side Rural The gradual and expected reduction in the annual cut will not have the significant impact that the curtailment of TSI activities will have. This, plus continuing conflicts over preservation issues, will seriously reduce a sense of control and community cohesion.

East Side Rural This Alternative, with its benefits to the ranching community, will have a stabilizing effect on these communities, which would have seen major changes stemming from the No-Change Alternative. Recreation growth will be curtailed, with the current social and economic patterns tending to remain as they are. There will be a greater sense of control and greater community cohesion than there would have been with the No-Change Alternative.

Southern Valleys The proposed recreational development in the Green Pine Valley (construction phase peaking in 1986) will be highly disruptive to those in the current community. Scarcity of land, housing, facilities, as well as serious conflict in values and ways of life will result from this Alternative. (Outputs from other parts of the Forest will have minimal effect.)

Data Requirements

The method utilizes both primary and secondary data, and generally explains how to obtain what is needed.

Accessibility

Unlimited.

Applicability

The approach described and concepts used are similar to and compatible with BLM procedures: most aspects would be directly applicable to any Resource Management Plan process in the Bureau.

Examples of Use

The method is currently being used in Region 6 and has been modified and used in Region 4 of the Forest Service.

Source/Contacts

See name.

Introduction to the Economic Analysis Section

Due to the fact that there are a number of different models and techniques available to assist the BLM field economist in determining the economic consequences associated with the various land management decisions, it was determined that it would be beneficial to distribute an informational packet describing various models and techniques to the field offices. This packet is not intended to be all inclusive, but rather a sampling of models and techniques that have been successfully used on projects similar to those that will likely be encountered by BLM field economists. It should also be mentioned that this packet will be periodically updated as new models or procedures become operational.

The following set of models and techniques has been organized into five categories. The first section consists of models that can be used for investment analyses such as B/C calculations for range improvements. The second section provides a synopsis of the various statistical and mathematical tools that are resident on the Honeywell system located at the Denver Federal Center. The third section covers a number of regional impact models that could prove useful in analyzing the economic impacts associated with, for example, energy development. The fourth section provides the reader with a couple of analytical procedures for determining the natural population growth which can be balanced against the projected demand for labor, and the residual can then be viewed as in-migration. This section also provides a mechanical method for distributing the projected increase in population to the various population centers. And finally, the fifth section contains several unrelated miscellaneous models. The first would be useful in estimating the present value to the lessee of federal coal tracts offered for competitive sale. The second model in this section is used to determine an optimal national distribution or transportation pattern for coal. The third presentation presents a practical discussion of the application of linear programming. The fourth presentation discusses a computerized process for calculating farm budgets in Idaho, which might have a broader application should data files be developed for other states. And the last presentation describes a petroleum activity and decision simulation to probabilistically model major activities involved in oil and gas exploration, development, production and transportation under conditions of uncertainty.

For each model, technique, or approach an individual contact has been identified who can assist the field staff in its application. For models or techniques which are resident on the Honeywell system, assistance can also be obtained by contacting Customer Service (D-200) at the Denver Service Center.

PROGRAMS FOR ANALYZING THE EFFICIENCY OF ALTERNATIVE INVESTMENT OPPORTUNITIES

1. NAME MTVEST (a computer program to evaluate forest investment opportunities

2. DESCRIPTION

a. General Description

Decisionmaking in forestry often involves analyzing forestry projects and programs as alternative investment opportunities. MTVEST is a computer program designed to help users evaluate these investments. Data input requirements are extremely flexible, including formatted, conversational and free-format modes. The program accepts up to 100 base problems and alternatives, up to 300 individual records in the primary data input file and up to 100 individual cost and revenue records per base problem or alternative. Records can be associated with single payments, equal annual payments and payments involving constant change. Discount rates of 5 and 10 percent are automatically provided; users specify up to three additional rates. A provision is also made for inflation and real value increases.

b. Strengths

MTVEST is a computer program designed to help assess the economic efficiency of forestry investment alternatives, be they projects or programs. The MTVEST computer program can be executed by remote terminal or batch, using punched cards, magnetic tape or disk as the input medium. How program execution occurs depends on the configuration of the computer system available to the user. The purpose of MTVEST is to provide one computer program that meets a wide variety of needs, is simple to operate, and provides comprehensive output in a readily understandable format. The main advantage of MTVEST over other similar programs is its input and output flexibility. Data input can be accomplished via any one of three modes: conversational, free-format, or fixed-format. Output takes the form of several tables displaying data inputs, project rankings on the basis of several criteria, and other desired project comparisons. Investment criteria include present net worth, internal rate of return, benefit-cost ratio, land expectation value, and annual equivalent value. Capability for sensitivity analysis together with inflation and real value increase is provided.

c. Data Requirements

MTVEST is simple in concept, designed to minimize the amount of data that must be specified or provided; it does this through elimination of input data duplication. The principle underlying MTVEST is that of the "base" problem and "alternatives to the base." A base problem is a set of information that fully describes an investment situation in terms of the elements of value flow -- level, timing, and type of cost or benefit. Here is how it works: enter all the data needed to

specify the base problem; data for alternatives are entered only where an alternative differs from the base problem. That is, MTVEST automatically ascribes to an alternative for every piece of data in the base problem. Users then specify data for each alternative by adding data to, modifying, and deleting data from the base problem. This MTVEST feature not only helps minimize entry of duplicate data but also eliminates initial confusion for inexperienced users.

MTVEST users should determine the best way to organize data before attempting to create an input data file. All program features in MTVEST are applicable to both base problems and alternatives to the base. Users should seek the optimal combination of base problems and form the following analyses on each project: discounted costs and revenues of project items at a user-specified discount rate and a summary project evaluation on the basis of benefit-cost (B/C) ratio, present net worth (PNW), annual equivalent value (AEV), and land expectation value (LEV), each at five discount rates, together with project internal rate of return (IRR). Depending on users's desire and the number of projects being evaluated, MTVEST can additionally provide sensitivity analysis, detailed item comparisons (A and B Option), analysis of opportunity costs (Opportunity Cost Feature), aggregation of similar cost and benefit items (Combination Feature), comparison and ranking of all projects (both base problems and alternatives) by eight investment criteria, and a marginal analysis summary.

3. ACCESSIBILITY

This model is currently on the United States Department of Agriculture's computer located at the Ft. Collins Computer Center.

4. APPLICABILITY

MTVEST can be used for investment analysis in forest planning.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

This model has been used for investment analyses in the San Juan, Grand Mesa, Uncompahgre, and Gunnison National Forests.

6. SOURCE/CONTACTS

There is a user manual for MTVEST and for further information contact:

United States Forest Service
John Devilbiss
11177 West 8th Avenue
P. O. Box 25127
Lakewood, CO 80225

Telephone No.: 303-234-3820

1. NAME: BCI

2. DESCRIPTION

a. General Description

This is a program for discounting benefits and costs. It calculates the benefit/cost ratio and net benefits. An advantage to the program is that it shows the discount factor applied to each year's benefits and costs. Disadvantages are that it doesn't calculate internal rate of return. Also, in order to vary the discount rate the program must be rerun. Data requirements are the benefits and costs by year for the life of the project.

3. ACCESSIBILITY

This program is located on the Bureau's Honeywell computer system. The access is by logging onto the Honeywell 66/80 and typing:

BRN FMRDB/BCI,R

4. APPLICABILITY

This program would be applicable for AMP benefit/cost analysis. It would be especially useful for the user who is not too familiar with discounting or discount factors.

5. EXAMPLE OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

Illustrated on next page.

6. SOURCE/CONTACT

Instructions for using this program are in "A Primer for the Computer Language BASIC and Cost/Benefit Analysis." Contact person is John Wong, Denver Service Center.

```
*BRN FMRDB/BC1,R


HOW MANY YEARS ARE PROJECTED?5
WHAT IS THE PERCENTAGE DISCOUNT RATE?7.625
YR      1  BENEFITS?500
YR      1  COSTS?1500
YR      2  BENEFITS?1000
YR      2  COSTS?500
YR      3  BENEFITS?1500
YR      3  COSTS?250
YR      4  BENEFITS?1500
YR      4  COSTS?250
YR      5  BENEFITS?1500
YR      5  COSTS?250

  YEAR  BENEFITS  DIS. FACTOR   DIS. BENEFITS
     1       500      .92915             465
     2      1000      .86332             863
     3      1500      .80216            1203
     4      1500      .74533            1118
     5      1500      .69252            1039
TOTALS      6000                        4688

  YEAR     COSTS  DIS. FACTOR      DIS. COSTS
     1      1500      .92915            1394
     2       500      .86332             432
     3       250      .80216             201
     4       250      .74533             186
     5       250      .69252             173
TOTALS      2750                        2385


        B/C RATIO=  1.965259
        NET BENEFITS=   2302.522
```

1. NAME: BC2

2. DESCRIPTION

a. General Description

This program is similar to BC1 except:

1) It dispenses with showing discount factors;

2) It takes as input capital costs, operating costs, and benefits;

3) In addition to a gross benefit/cost ratio it also calculates a net benefit/cost ratio (benefits minus operating costs divided by capital costs);

4) It computes annual net benefits;

5) It computes the internal rate of return.

Varying the discount rate is easy with this program, re-entering of cost and benefit data is not required. The major disadvantage to this program is that the distinction between gross benefit/cost ratio and net benefit/cost ratio can be confusing.

3. ACCESSIBILITY

This program is located on the Bureau's Honeywell computer system. Access is by logging onto the Honeywell 66/80 and typing:

BRN FMRD8/BC2,R

4. APPLICABILITY

This program would be applicable for range or other types of benefit/cost analysis. Especially useful is sensitivity analysis with respect to discount rate is desired.

5. EXAMPLE OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

Illustrated on next page.

6. SOURCE/CONTACT

Instructions on using this program are in "A Primer for the Computer Language BASIC and Cost/Benefit Analysis." Contact person is John Wong, Denver Service Center.

```
BRN FMRDB/BC2,R
COMMAND UNKNOWN
*BRN FMRDB/BC2,R

NO. OF YRS OF CAPITAL COSTS?1

TYPE IN CAPITAL COSTS FOR EACH YEAR
YR      1 ?1500
HOW MANY YEARS ARE PROJECTED?5
TYPE IN OPERATING COSTS
YR      1 ?0
YR      2 ?500
YR      3 ?250
YR      4 ?250
YR      5 ?250
TYPE IN BENEFITS
YR      1 ?500
YR      2 ?1000
YR      3 ?1500
YR      4 ?1500
YR      5 ?1500
```

UNDISCOUNTED AMOUNTS

YEAR	CAPITAL COSTS	OPER. COSTS	BENEFITS
1	1500	0	500
2	0	500	1000
3	0	250	1500
4	0	250	1500
5	0	250	1500
TOTALS	1500	1250	6000

```
WHAT IS YOUR PERCENTAGE DISCOUNT RATE?7.625

USING A DISCOUNT RATE OF   7.625 PERCENT,
DISCOUNTED CAPITAL COSTS=   1393.728
DISCOUNTED OPERATING COSTS=   991.6643
DISCOUNTED BENEFITS=   4687.915
THE GROSS BENEFIT/COST RATIO=   1.965259
THE NET BENEFIT/COST RATIO= 2.65206
THE NET BENEFITS=   2302.522
THE ANNUAL NET BENEFITS=   1162.537

DO YOU WANT THESE RE-FIGURED WITH A DIFFERENT RATE?YES
WHAT IS YOUR PERCENTAGE DISCOUNT RATE?11.0

USING A DISCOUNT RATE OF   11 PERCENT,
DISCOUNTED CAPITAL COSTS=   1351.351
DISCOUNTED OPERATING COSTS=   901.6546
DISCOUNTED BENEFITS=   4237.133
THE GROSS BENEFIT/COST RATIO=   1.880658
THE NET BENEFIT/COST RATIO=   2.468254
THE NET BENEFITS=   1984.127
THE ANNUAL NET BENEFITS=   1146.442
```



```
DO YOU WANT THESE RE-FIGURED WITH A DIFFERENT RATE?NO
THE INTERNAL RATE OF RETURN=   79.73633   PERCENT
```

1. NAME: Disc 1

2. DESCRIPTION

a. General Description

This is a program for discounting benefits and costs. The program calculates the benefit/cost ratio and internal rate of return. It is easy to use and is an interactive, conversational type program. Projects or proposals with up to 30-year lifetimes can be analyzed. The major limitation is the inability to vary the discount rate without re-entering the data set. Data requirements are the streams of benefits and costs by year.

3. ACCESSIBILITY

This program is located on the Bureau's Honeywell computer system. Access commands are:

```
GET IG82/DISC1,R
FRN DISC1
```

4. APPLICABILITY

This program has been, and is being, used in Idaho in grazing benefit/cost analysis.

5. EXAMPLE OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

Illustrated on next page.

6. SOURCE/CONTACT

There are no user manuals available for the DISC 1 program. Primary contact is Stanley C. Frazier, Agricultural Economist, Idaho State Office.

```
*get is82/disc1,r
*frn disc1
```

BUREAU OF LAND MANAGEMENT
IDAHO STATE OFFICE
PLANNING AND ENVIRONMENTAL COORDINATION DIVISION
DISCOUNTING PROGRAM FOR BENEFITS AND COSTS

```
WHAT DISCOUNT RATE DO YOU WANT TO  USE?

(THE WATER RESOURCES COUNCIL DISCOUNT  RATE FOR FY 1982 IS 7.625)
=7.625
WHAT IS THE LIFETIME OF THE PROJECT IN YEARS
=5
WRITE BENEFITS FOR YEAR  1
=1500
WRITE COSTS FOR  YEAR 1
=4500
WRITE BENEFITS FOR YEAR  2
=1500
WRITE COSTS FOR  YEAR 2
=250
WRITE BENEFITS FOR YEAR  3
=1750
WRITE COSTS FOR  YEAR 3
=125
WRITE BENEFITS FOR YEAR  4
=2000
WRITE COSTS FOR  YEAR 4
=125
WRITE BENEFITS FOR YEAR  5
=2500
WRITE COSTS FOR  YEAR 5
=125
```

YEAR	BENEFITS	COSTS
1	1394.	4181.
2	1295.	216.
3	1404.	100.
4	1491.	93.
5	1731.	87.
TOTALS	7314.	4677.

BENEFIT COST RATIO = 1.564

INTERNAL RATE OF RETURN = 40.47

STATISTICAL AND MATHEMATICAL
PROGRAMS ON BLM's HONEYWELL

1. NAME: SPSS

2. DESCRIPTION:

a. General Description

Statistical Package for the Social Sciences (SPSS) is an integrated system of computer programs designed for the analysis of social science data. The system provides a unified and comprehensive package that enables the user to perform many different types of data analysis in a simple and convenient manner. SPSS allows a great deal of flexibility in the format of data. It provides the user with a comprehensive set of procedures for data transformation and file manipulation, and it offers the researcher a larger number of statistical routines commonly used in the social sciences. SPSS is intended for the statistical user of intermediate ability.

b. Strengths

(1) The number of cases in the input data set is unlimited.

(2) SPSS uses a parameter control language easily learned by the user and well documented in the SPSS Users Guide.

(3) The SPSS Users Guide is oriented toward the non-statistican user.

c. Limitations

(1) SPSS has a limit of 500 variables for any given file.

(2) SPSS operates in the batch mode. This requires that the SPSS user become familiar with the rudimentaries of job control language (JCL) and the Time Sharing/Batch interface subsystems.

d. Data Requirements

The data required are those necessary to perform most any statistical analysis.

In addition to the usual descriptive statistics, simple frequency distributions, and cross-tabulations, SPSS contains procedures for simple correlation (for both ordinal and interval data), partial correlation, means and variances for stratified subpopulations, one-way and n-way analysis of variance (including multiple classification analysis tables), multiple regression, discriminant analysis, scatter diagrams, factor analysis, canonical correlations, and Guttman Scaling. The data-management facilities can be used to modify a file of data permanently and can also be used in conjunction with any of the statistical procedures. These facilities enable the user to generate new variables which are mathematical and/or logical combinations of existing variables, to recode variables, and to sample, select, or weigh specified cases. Furthermore, the user can add to or alter the data cases or the data-descriptional information in the file, such as labels, missing-value codes, etc.

3. ACCESSIBILITY:

This package is currently operational on the BLM's Honeywell 66/80 computer located at the Denver Service Center.

4. SOURCE/CONTACTS:

There are two users guides to the SPSS package:

(1) SPSS: Statistical Package for the Social Sciences by Nie, Norman H. et al, 2nd edition, published by McGraw Hill.

(2) SPSS Update by Hull, C. Hadlai and Nie, Norman H. published by McGraw Hill.

Item one is the complete package documentation and item two documents more recent enhancements to the package.

An additional document "Notes on the Use of SPSS for the Honeywell Computer" describes the specific use of SPSS on a Honeywell computer. This latter document, as well as technical assistance in the use of SPSS, is available at the Denver Service Center by contacting Mike Garratt, Division of Scientific Systems Development (D-440, telephone FTS 234-5673).

1. NAME: STATPACK

2. DESCRIPTION:

a. General Description

The primary purpose of the Statistical Package (STATPACK) is to permit the user to interact with the computer through a remote terminal while he is performing statistical analyses. STATPACK consists of 21 analyses. These programs are designed to ask the user to enter his problem parameters and variables and to make decisions at certain key points in the analyses. The communication between the user and the computer is carried out in a conversational manner. Thus, the user can solve his problem from a remote terminal without knowing anything about computers and programming. However, it is assumed that anyone using the various analyses is familiar with the concepts involved.

b. Strengths

Some of the characteristics of the Statistical Package are as follows:

(1) Communication between the user and the computer is conversational.

(2) The programs can be run from most remote teletype terminals.

(3) The programs perform error checking for input parameters and data and give the user the opportunity to correct possible errors.

(4) Data may be added, replaced, deleted, transformed or generated at the user's specifications.

(5) Multiple data sets may be processed from an input file.

(6) Input data may be created by a BASIC or FORTRAN program for use as an input file.

(7) Many alternatives are provided in each analysis.

(8) Tutorial instructions are provided at the user's request.

(9) The programs permit the user to control the sequence of operations and the amount of output.

c. Limitations

For most of the analyses in STATPACK the maximum size of data matrix is 250 rows (observations) and 15 columns (variables). For an analysis-of-variance problem, the total number of data, T, should be less than or equal to 1500, where

$$T = (L_1 + 1) * (L_2 + 1) *...* (L_k + 1)$$

and the L's are the levels of k factors. No more than seven factors may be specified. Other limitations are indicated during program execution wherever applicable. No more than 72 characters will be printed on any line regardless of a WIDTH setting greater than 72.

d. Data Requirements

The data required are those necessary to perform any one of the following 21 analyses available in STATPACK:

Edit
Transformation
Elementary Statistics
Correlation
Cross Tabulation
Scatter Diagram
Histogram
Line Plot
Rank Correlation
Chi-Square
t Test
Regression
Stepwise Regression
Multiple Regression
Polynomial Regression
Analysis of Variance
Canonical Correlation
Factor Analysis
Discriminant Analysis
Exponential Smoothing
Probit Analysis

Input data may be entered in the following ways:

(1) Typed at a terminal keyboard during the running of the program.

(2) Entered from an input file during the running of the program.

(3) A combination of 1 and 2.

When reading data in DV (disk in variable format) or DF (disk in free format), the record is limited to 80 characters. If DV, all variables in one row must be in one record.

3. ACCESSIBILITY:

This package is currently operational on the BLM's Honeywell 66/80 computer located at the Denver Service Center.

4. SOURCE/CONTACTS:

The Branch of Technical User Support, DSC (D-221, telephone FTS 234-6915) may be contacted to obtain copies of the STATPACK Reference Manual. Technical assistance in the use of STATPACK can be obtained by contacting Mike Garratt, Division of Scientific Systems Development, DSC, (D-440, telephone FTS 234-5673).

1. NAME: BMD/BMDP

2. DESCRIPTION:

a. General Description

The BMD and BMDP computer programs are statistical packages designed for the advanced statistical user. The BMDP computer programs are designed to aid data analysis by providing methods ranging from simple data display and description to advanced statistical techniques. Data are usually analyzed by an iterative "examine and modify" series of steps. First the data are examined for unreasonable values, graphically and numerically. If unreasonable values are found they are checked and, if possible, corrected. An analysis is then performed. This analysis may identify other inconsistent observations or indicate that further analyses are needed. The BMDP programs are designed to handle all steps in an analysis, from the simple to the sophisticated.

b. Strengths

(1) The BMDP package can handle very large data sets.

(2) The BMDP packages are capable of performing statistical analyses available in few other packages (e.g., cluster analysis and repeat measure analysis).

c. Limitations

(1) The BMD package is an older version (1970) provided by Honeywell.

(2) The BMD and BMDP control language is somewhat complex making it more difficult to learn and use.

d. Data Requirements

The data required are those necessary to perform most any statistical analysis. The programs are loosely classified into series:

D: data description
F: frequency tables
R: regression analysis
V: analysis of variance
M: multivariate analysis
L: life tables and survival analysis
S: special (miscellaneous)

3. ACCESSIBILITY

The packages are currently operational on the BLM's Honeywell 66/80 computer located at the Denver Service Center.

4. SOURCE/CONTACTS:

The users guides to these packages are:

(a) BMDP Biomedical Computer Programs P series, 1979, Dixon, W.J. and Brown , M.B., editors.

(b) BMD Biomedical Computer Programs, 1970, Dixon, W.J., editor.

Available from:

University of California Press
2223 Fulton Street
Berkeley, California 94720

Technical assistance in the use of BMD and BMDP is available at the Denver Service Center by contacting Mike Garratt, Division of Scientific Systems Development (D-440, telephone FTS 234-5673).

1. NAME: MPS

2. DESCRIPTION:

a. General Description

MPS is Honeywell's Mathematical Programming System for the Series 60 Level 66 computers.

Mathematical programming is a broad term that applies to several mathematical techniques for determining the optimal allocation of resources, such as capital or raw materials, to achieve a particular objective, such as maximizing project or minimizing cost, when the resources can be allocated in alternate ways.

Problems solved by mathematical programming generally have certain characteristics:

- A specific goal - Maximize profit, minimize cost, or minimize elapsed time.

- A large number of variables -- Available quantities of raw materials, demand for end products, available machine time and labor force.

- Limited resources -- The availability of a fixed number of machines required in the production of an end product.

Solving these problems requires a systematic method to represent the goal or objective of the system under study and to describe the limitations or constraints of the system. Mathematical programming can optimize the objective within the constraints imposed by limited resources and the product demands for those resources.

MPS offers the following selection of mathematical programming techniques:

- Linear programming -- The objective and constraints of the system can all be described with linear algebraic equations.

- Mixed integer programming -- The objective and constraints of the system are all expressed with linear algebraic equations as in linear programming, except that some variables are allowed to take on only integer values (for example, it is not practical to build 4.5 oil tankers).

- Transportation -- Problems involving only transportation of goods from supplies to destinations are a special case and are treated by special purpose routines to take advantage of their characteristics.

- Separable programming -- A special type of nonlinear problem where some of the constraints (or possibly the objective function) are nonlinear but of a form that they can be approximated by linear relations.

b. Strengths

MPS can accept problem data for other widely known or earlier mathematical programming systems, such as SHARE standard format, IBM's MPSX, and Honeywell's LP600/6000. It also has the capacity to:

- Solve standard problems with up to 16,000 rows (constraints) and 262,000 columns (variables).

- Solve mixed integer problems with special set, integer, and zero/one variables. There is no logical limit on the number of variables; however, solution time imposes a practical limit dependent upon problem difficulty.

- Handle transportation matrices containing up to 16,000 sources and 16,000 destinations, or vice versa.

c. System Characteristics

MPS is a large-scale mathematical programming system that makes available to the user a wide variety of aids and utility functions in addition to the basic mathematical solution techniques. A special-purpose programming language, the agenda control language (ACL), permits user control of information flow during the entire MPS run. Specific features available in MPS are detailed below.

(1) Problem Definition:

- Up to 18-character, three-part row and column name
- Free or restricted variables (positive, negative, zero, or integer level)
- Upper and/or lower variable bounds
- Row and/or column scales
- Bounded slack variables
- Multiple right-hand sides and objective functions
- Matrix definition in variable field format
- Separable, GUB, integer, and special set variables defined explicitly without special name conventions.

(2) Techniques

- Primal, dual, separable, transportation, mixed integer, and generalized upper bound algorithms
- User-controlled multiple and/or partial pricing
- Crashing capability to reach feasibility quickly
- Slack variables generated automatically
- Double-precision (72 bits) arithmetic
- Automatic controls to prevent looping

(3) Agenda Control Language

- Problem-oriented, English like control language
- Preprocessed agenda control program
- Complete programming logic, including subroutine linkage, arithmetic, and macro definition capability
- Execution in a compile-and-go environment
- Operation under Level 66 GCOS operating system, using multi-programming and input/output file control features

(4) Files and Interfaces

- Complete communication with Common File Management System (CFMS) for matrix generation, report writing, and data base manipulation; CFMS may be executed as a separate activity or it may be called as a subroutine from the agenda control language
- Intermediate solution results
- Complete problem revision capability including linear forms and the deletion or insertion of any part of the matrix
- Input/output compatibility with FORTRAN programs
- Call capability with external user-written programs

(5) Postoptimal Operation (Sensitivity Analysis)

- Ranging of the RHS, objective function matrix columns, solution values, or an individual matrix element
- Parameterization of the RHS, objective function, a matrix colu..., or a matrix row
- Simultaneous parameterization of the RHS and objective function
- Analysis of the effects (on the problem solution) of removing basic variables and introducing nonbasic variables
- Fully automatic parameter stepping
- User-controlled output frequency
- User-controlled row and column selection for output
- Capability for both dynamic and static postoptimal analyses

(6) Output Capabilities

- Standard solution data, including problem element summaries and values of structural variables (X-values)
- Automatic generation of restart information
- Preparation of standard reports
- Preparation of special reports through the CFMS language
- Matrix picturing by range symbols
- Matrix display in row or column order for any subset of the entire matrix
- Limiting of output volume by specifying particular subsets of rows or columns
- Controlling of output frequency with internal control parameters

(7) Configuration Requirements

(a) Local Job Entry

MPS requires the following minimum equipment configuration to operate in the local job entry dimension:

- Level 66 central processor system and console with 32K words of main memory, exclusive of the memory required for the operating system
- Magnetic type subsystem with one magnetic type unit required to initialize system
- Bulk storage
- Card reader
- Printer
- Card punch (if punched card output is desired)

(b) Remote Job Entry

For remote job entry, the configuration given for local job entry is required, plus the additional equipment and systems software to support the GCOS Time Sharing System. The user must also have available a remote terminal device. Remote terminals can be connected to the Level 66 central system through a standard dial telephone system.

3. ACCESSIBILITY:

MPS Version 3.3 is currently operational on the BLM's Honeywell 66/80 computer at the Denver Service Center.

4. EXAMPLES of USE:

MPS is being used for allocation of vegetation to consumptive users and for estimating economic impacts of adjustments in grazing on federal lands.

5. SOURCE/CONTACTS:

An MPS user's manual is available from Honeywell and from DSC. For further information contact Frederick Martinson, Operations Research Analyst, Denver Federal Center, Bldg. 50, Denver, Colorado 80225, FTS 234-4620.

1. NAME: A121/LPWASHDC

2. DESCRIPTION:

A121/LPWASHDC is an interactive linear programming code. It offers a quick solution to small linear programming problems. Data are entered interactively or from a file. Problem dimensions cannot exceed 30 constraints and 50 structural variables. Language: FORTRAN

3. ACCESSIBILITY:

LPWASHDC is currently operational on the BLM's Honeywell 66/80 computer.

4. SOURCE/CONTACTS:

A write-up is available from Frederick Martinson, Operations Research Analyst, Denver Federal Center, Bldg. 50, Denver, Colorado 80225, FTS 234-4620.

1. NAME: A121/LPGLOVER

2. DESCRIPTION:

A121/LPGLOVER is an interactive linear programming code for bounded variables. It uses the condensed simplex tableau method and can solve the linear programming problem via either the primal or the dual method. Intermediate tableaux can be displayed at will. Problem dimensions are limited to a 55 x 55 initial tableau. Language: FORTRAN

3. ACCESSIBILITY:

LPGLOVER is currently operational on the BLM's Honeywell 66/80 computer.

4. SOURCE/CONTACTS:

A write-up is available from Frederick Martinson, Operations Research Analyst, Denver Federal Center, Bldg. 50, Denver, Colorado 80225, FTS 234-4620.

1. NAME: Time Sharing Applications Library

2. DESCRIPTION:

The T/S Applications Library contains a collection of T/S programs grouped into four categories: Mathematics, Statistics, Management Science, and Business and Finance. A current catalog of the programs contained in the library can be obtained by typing at the terminal: LIST TSS-LIBRARY/CATALOG.

3. ACCESSIBILITY:

The T/S Application Library is resident on the BLM's Honeywell 66/80 computer. However, because of lack of disk storage space, some of the programs may have been archived and hence not be readily accessible. To have the desired program(s) restored, contact the Branch of User Support, FTS 234-6915, or the contact indicated below.

4. SOURCE/CONTACT:

T/S Application Library manuals are available from Honeywell or from DSC. For further information contact Frederick Martinson, Operations Research Analyst, Denver Federal Center, Bldg. 50, Denver, Colorado 80225, FTS 234-4620.

REGIONAL IMPACT MODELS

1. NAME: BLM's Regional Input/Output Model

2. DESCRIPTION

a. General Description

An input-output model empirically illustrates the interdependent economic structure of the study region. This model provides an account of transactions for each sector of the economy, a calculation of the input requirements of these sectors and a measurement of the effects of growth in demand for the outputs of each sector. Essentially, the model is a system of double-entry bookkeeping such that sales and purchases by each sector to and from all other sectors are accounted for and measured.

The model consists of two major components -- those transactions which are identified as intermediate transactions and those which are termed final. Intermediate transactions consist of the purchase and sale of intermediate goods (i.e., those which are subject to further local processing). Final transactions include all purchases and sales from or to sectors which are external to the model (i.e., to sectors not identified as intermediate or producing sectors). Such transactions would include, for example, sales from intermediate sectors to investment, governments, and exports and purchases by intermediate sectors from governments, construction, or in the form of imports.

The model is driven by the final demand sectors. Thus, if it is known that sales to government, investment, or exports by any particular sector are going to change, the model estimates the impacts of this change on the entire economy. These impacts, whether measured in terms of employment, income, or the value of production provide consistent estimates which mutually and simultaneously satisfy all requirements for intermediate and final production. Once the essentials of the model have been identified and the basic empirical description of economic transactions developed, forecasting with the analytical technique requires only the specification of appropriate changes in final demand.

The input-output methodology is simply to divide the industries of the regional economy into two groups: (1) businesses which service and supply inputs mainly to other businesses within the region; and (2) business firms which sell mainly to customers outside the region. The latter group of firms is often termed "basic" industries. "Basic" industries along with government, investment, and, if desired, households form the demands which determine the business activity of the local suppliers of raw materials, labor, and processed goods. The local economy is said to be "driven" by the growth of basic industry, government, investments, and other "final demands." Thus, in order to project local business activity, it is important to determine the key economic sectors. These driving sectors will be the businesses which sell most of their output outside the region but purchase a significant share of their inputs inside the region. In order to be of major importance, the businesses must also have a significant size and show expectations of volatility (high future growth or, possibly, high rates of decline).

In order to determine the nature of each industry in a region and to see whether the industry is one of the important driving sectors, a transactions table is constructed. This transactions table is a system of double-entry bookkeeping such that sales and purchases by each industry to and from each other industry (as well as labor, government, and exports) are accounted for and measured.

Two features of the input-output technique make it particularly desirable for the analysis of growth and development in a regional economy. First, the techniques provide information on sales and related variables (such as employment and income) on an industry-by-industry basis. This information is much more useful than more generally aggregated data. Second, the projections of future business activity in the region are consistent. That is, the projected value of production by each sector is the minimum required to meet the needs of other industries in the region and projected exports. Inputs and outputs must be in accounting balance at all times. This simultaneous balancing of production to requirements among industries in the region provides much more realistic projections than isolated forecasts for individual industries.

b. Strengths:

The strength of the input-output model lies in its capability not only to describe the interdependence existing among sectors of an economy but also in the capacity to demonstrate sector by sector the total consequences of any number of development scenarios. The model is thus both descriptive and analytical. The descriptive components are accommodated through the collection of extensive primary data from firms and agencies within the region, and subsequent tabulation of the data in a form consistent with the interindustry framework. The analytical phase consists of the impact analysis, development of the various multipliers, and consistent forecasting under alternative resource development scenarios.

c. Limitations:

Input-output analysis is generally a static analysis that is used to analyze a dynamic situation. This means that the technical coefficients are assumed to be constant over time when in fact they are likely to change. This may or may not cause serious problems depending on the stability of the economy being analyzed.

d. Data Requirements:

The data requirements for the BLM input-output model varies depending on the amount of information available locally. For example, if there have been local studies that built transactions tables, these tables can provide the necessary data to run the model. On the other hand, if there has not been any input-output research in the area, secondary or primary data for the transaction table will be required. Where feasible, primary data is preferable. However, it is possible to build a transaction table for a specific area through a disaggregation process of existing national or regional tables.

The following list represents the data requirements for the I/O analysis:

(1) An industry-by-industry sales and purchases distribution, measured in dollars.

(2) A measurement of the extent to which each industry purchases labor, raw materials, and processed goods within the study region as opposed to imports from outside the region.

(3) Employment on an industry-by-industry basis in the study region.

3. ACCESSIBILITY:

The program that runs the input-output analysis is housed on the Bureau of Land Management's computer located at the Denver Service Center. It is accessible through the use of remote terminals located throughout the Bureau.

4. APPLICABILITY:

Input-output analysis provides a useful tool that can be used to quickly assess the economic ramifications of nearly any land management decision.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

a. The Bureau Planning Process
b. Environmental Statements
c. Environmental Assessments
d. Determining the Economic Impacts Associated with Specific Bureau Programs such as Forestry and Range.

6. SOURCE/CONTACTS:

The user manuals for the input-output analysis are available. Contact Roy L. Allen, Wyoming State Economist, P.O. Box 1828, Cheyenne, Wyoming 82001, FTS 328-2358.

1. NAME: MSO Economic/Demographic Computer Model

2. DESCRIPTION:

a. General Description

This model utilizes input/output (I/O) analysis as the economic impact assessment framework. I/O was chosen over economic base approaches because I/O provides considerably more detailed impact estimates (e.g., gross business volume and employment by economic sector). Additionally, I/O provides explicit patterns in assessing impacts of various development proposals.

The MSO E/D model consists of four modules:

(1) I/O module
(2) Cohort survival module
(3) Residential allocation module
(4) Fiscal impact module

Interaction of these four modules is shown in Figure 1.

Net migration into (or out of) the study area is calculated based upon a comparison of labor demand with indigeneous labor supply. This comparison is made via the E/D interface (re Fig. 1).

Model output consists of the following annual forecasts for both baseline and impact scenarios:

(1) Regional personal income, business activity, per capita personal income.

(2) Regional, county and community population and employment (direct and indirect).

(3) County population by age and sex.

(4) Regional, county and community net fiscal balance (surplus or deficit of total forecasted expenditures vs. revenues).

(5) Community specific primary and secondary school enrollments.

(6) County and community specific housing forecasts (single family, apartments, ad hoc housing, trailers).

b. Strengths

The strengths of the MSO E/D model lie in the ability of the model to predict economic changes at the county and community level for a wide range of impacts. The model can be specified to define a "region" as any aggregation of counties within the model's geographic scope (i.e., central and eastern Montana and entire state of North Dakota). The model user will be able to change several operational model variables to suit conditions (e.g., length of projection period, number and type of projects, location of projects, start dates, gravity powers for construction, operation and indirect workers,

birth rates, community attractiveness indices, unemployment rates, inflation rate and major tax rates such as severance taxes, sales taxes and others).

c. Limitations

Because of the broad spectrum of communities and counties which could be included in a given run, it is advisable to check user specified variables for accuracy and compatibility with any special circumstances which could be present.

As with all models of this sort, forecasts into the near future will be more reliable than those out beyond 1990, for example.

d. Data Requirements

Data requirements (input) include:

(1) Direct work force and payroll totals for projects in each scenario.
(2) Capital expenditures.
(3) Location of coal mines/conversion facilities.
(4) Tonnage of coal mined and/or converted.

3. ACCESSIBILITY:

The MSO E/D model is currently being loaded on the Agnet computer system out of Lincoln, Nebraska. The MSO will utilize the Bozeman, Montana Agnet office as primary contact with the system.

4. APPLICABILITY:

The model is most applicable to energy related E.A. work. In general, any project or group of projects which would result in significant changes in employment and population would be appropriate for model usage. Coal development, oil and gas activity, oil shale developments and hard rock mining are some of the activities which would be compatible with model usage. Baseline forecasts would be useful in SEPs, PAAs and MFPs.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

This model will be used in the regional analysis phase of the Fort Union Regional Coal EIS (MSO lead). A forerunner of the MSO E/D model (i.e., North Dakota Regional Environmental Assessment Program (REAP) Model) was used in the West Central North Dakota Regional EIS (MSO lead).

6. SOURCE/CONTACTS:

Loren Cabe, State Office Economist, Montana State Office, 222 North 32nd Street, P.O. Box 30157, Billings, Montana 59101, FTS 585-6632; Comm. 406/657-6632. User's Manual will be available.

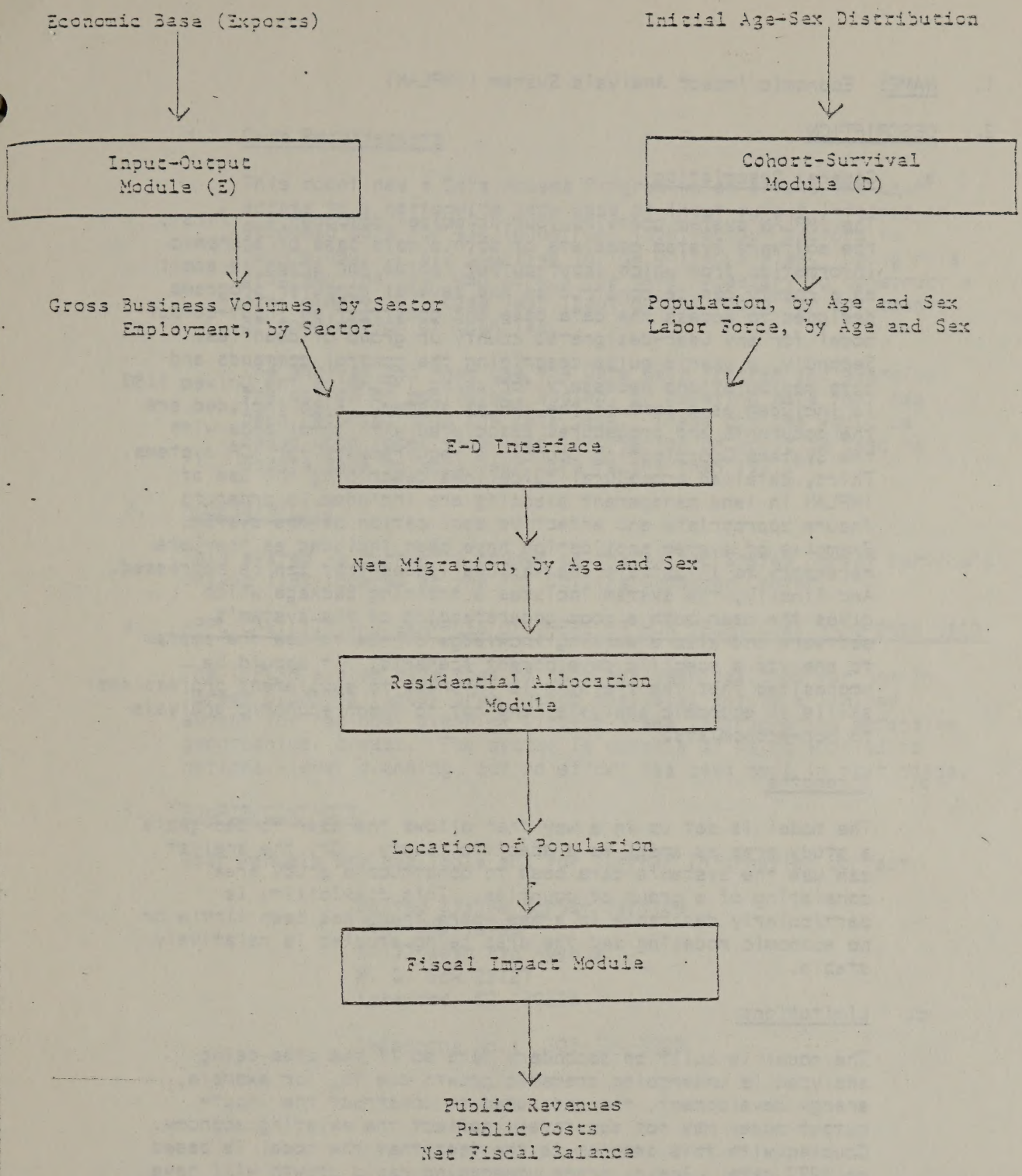

Figure 1
Data and Output Flows of Economic-Demographic Model

1. NAME: Economic Impact Analysis System (IMPLAN)

2. DESCRIPTION

a. General Description

The IMPLAN system contains four principal components. First, the software system consists of both a data base of economic information from which input-output tables for areas as small as a county can be constructed and several computer programs designed to access the data base and construct an input-output model for any user-designated county or group of counties. Secondly, a user's guide describing the control commands and data manipulations necessary for using IMPLAN on the Univac 1180 is included as a part of the IMPLAN system. Also included are the documents and procedures associated with compliance with the Systems Coordinating Council's requirements for ADP systems. Third, detailed procedural guidelines describing the use of IMPLAN in land management planning are included in order to insure appropriate and effective application of the system. Examples of system application have been included as they are necessary to illustrate the various issues that can be addressed. And finally, the system includes a training package which gives the user both a good understanding of the system's software and also a working knowledge of how to use the system to analyze a specific development scenario. It should be emphasized that the training is intended to supplement professional skills in economic analysis, and not to teach economic analysis to non-economists.

b. Strengths

The model is set up in a way that allows the user to designate a study area as small as a specific county. Or, the analyst can use the system's data base to construct a study area consisting of a group of counties. This flexibility is particularly desirable in areas where there has been little or no economic modeling and the area being studied is relatively stable.

c. Limitations

The model is built on secondary data so if the area being analyzed is undergoing dramatic growth due to, for example, energy development, the data used to construct the input-output model may not accurately reflect the existing economy. Coupled with this problem is the fact that the model is based on 1977 data. Again, areas undergoing rapid growth will have changed substantially since 1977 and therefore the input-output tables that are constructed will be out of date.

d. Data Requirements

This model has a Data Access Program which allows the user access to a nationwide data base of input-output information. Economic data for 472 industrial input-output sectors is maintained for all counties in the United States. Using this program, the user can obtain the data necessary to construct a preliminary 1977-base year input-output table for any county or combination of counties.

The analyst can then use the Data Edit Program and exercise the option of modifying, adding, or deleting data that has been reported from the data base. These changes would be based upon locally-derived information or could be used to update data to some year more recent than 1977.

3. ACCESSIBILITY

This system is currently housed on the United States Forest Service's Univac 1180 located at the Ft. Collins Computer Center.

4. APPLICABILITY AND EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

The IMPLAN system developed to date has been designed for use in forest planning (local area impact analysis) and to a limited extent for regional planning (impact areas incorporating extensive geographical areas). The system is capable of being applied to national-level planning, but no effort has been made in that usage.

5. SOURCE/CONTACTS

User manuals are available and for further information contact:

United States Forest Service
John Devilbiss
11177 West 8th Avenue
P. O. Box 25127
Lakewood, CO 80225

Telephone No.: 303-234-3820

1. NAME: Socioeconomic Impact System

2. DESCRIPTION

a. General Description

The Socioeconomic Impact System (SIS) is a tool for analyzing area economic impacts associated with a number of different Forest Service activities and forest outputs. In addition, it permits the user to analyze impacts that are independent of the Forest Service.

Two programs (INPUT and IMPACT) have been combined to create SIS. INPUT has been prepared to provide an interpretation of user-supplied inputs and offers the user an opportunity to check the inputs for errors. IMPACT processes the input files and produces reports on changes in earnings and employment within a state or RPA region. The two RPA region output options available within this system are the RPA Northeast region, which includes 12 states, (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and West Virginia) and the RPA Northcentral region, which includes 8 states (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin). Also, socio-economic impact information can be obtained from any one of these 20 states individually.

b. Strengths

SIS derives its simplicity from RIMS (Regional Industrial Multiplier System), and is based in part on work done for the Forest Service by the Bureau of Economic Analysis, U.S. Department of Commerce (Cartwright 1979). Changes to be analyzed are introduced either as Forest Service activity changes, or as forest output changes. SIS draws on its data base to convert these user-supplied changes into changes in final demand in the appropriate sectors of the underlying input-output model. The study area (state or RPA region) multiplier matrix is then applied to the final demand changes to yield gross output change by industry. This impact is converted to earnings and employment terms, and the earnings and employment impacts, both in absolute numbers and as percentages of existing levels, are reported.

c. Limitations

Since the underlying tool in this analysis is the input-output model, the limitations of the analysis are those of input-output. As a consequence, the user should exercise care in applying the system. Input-output analysis makes assumptions that certain characteristics apply to the economy and to the change imposed on it. Foremost among these is the assumption that changes can be represented by average relationships among industries. If, for example, the production of product Y requires, on the average, 10 cents of input Z per dollar of Y output, then increases in the output of Y are assumed to result in an increase in demand for Z as an input at the same rate - namely, 10

cents per dollar. Of almost equal importance is the assumption that the capacity needed to meet increases in demand is available. In general, these two assumptions are least likely to hold in the situation in which the change is either very large or very small.

d. Data Requirements

SIS offers the user a number of options for introducing changes that are likely to produce economic impacts. In the context of the system these changes are called events. A number of events may be tested for a given area, and together they are called a case. A case pertains to a specific area (state of RPA region) and may represent a set of interrelated changes or events, such as an increase in recreation use coupled with a decrease in timber harvest. Several cases can be analyzed in a single run.

An event can be one of three types. A Type A event involves direct Forest Service activities. The area impact associated with a Type A event stems from the purchases of goods, services and labor in the area that are required to carry out the activity. A Type B event involves an output of the forest, such as recreation use or sawlog production. The area impact associated with a Type B event stems from either the use of the output by an area industry (e.g., sawmills using sawlogs to produce lumber) or the use of the recreation services by visitors (resulting in purchases of goods and services from local outlets). These are also referred to as forward-linked effects. A Type C event is a final demand change in any one of the 70 industrial sectors. Thus, any industrial change, even though unrelated to the Forest Service or the forest, can be analyzed as a Type C event.

3. ACCESSIBILITY

This model is currently on the United States Department of Agriculture's computer located at the Ft. Collins computer center.

4. APPLICABILITY

This model could be used for assessing the economic impacts associated with actions that are precipitated by specific BLM land management decisions.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

This model was developed for the Forest Service and is being used to evaluate the economic opportunities to increase softwood production on private land. The Forest Service is also planning to use the model in their planning activities. Finally, the State of Maine is using the model to evaluate their forestry programs.

6. SOURCE/CONTACTS

There is a user manual available and for more information contact:

Max Keetch
2625 Redwing
Executive Plaza Bldg.
Suite 350
Ft. Collins, CO 80526

FTS 323-5265
Commercial 303/223-5025

1. NAME: Bureau of Reclamation Economic Assessment Model (BREAM)

2. DESCRIPTION:

a. General Description

BREAM can best be categorized as an economic/demographic simulation model that analyzes the implications of different assumed inputs for the population, employment, and income of a region. The root of this type of model can be traced to the Susquehanna River Basin Model developed by Batelle Memorial Institute (Hamilton, 1969). The Susquehanna model was the first to recognize both the interdependency and the need for consistency between the economic and demographic sectors. The concepts developed in this early model formed the basis for an economic/demographic model developed for San Diego, California (San Diego Comprehensive Planning Organization, 1972). By the mid-1970s, this class of models was becoming better known and was being adopted by several states for general planning purposes in order to produce county-level employment and population projections. For example, the Utah Process Economic/Demographic Model (UPED) and the Arizona Economic/Demographic Projections Model (EDPM) were developed at approximately the same time (Utah State Planning Coordinator, 1972; Arizona Office of Economic Planning and Development; 1977). The majority of economic/demographic simulation models have a similar structure built around three submodels. A demographic submodel accounts for population characteristics such as births; deaths, and the age-sex composition of the area. The supply of labor is determined from labor force participation rates and the "survived" population from the demographic submodel. An economic submodel determines labor demand derived from estimates of total employment. A labor market submodel then reconciles model/estimates of labor supply and labor demand. Labor market imbalances trigger either in- or out-migration from the area. Once labor market equilibrium is achieved, employment-migration is completed. The process results in projections of employment, income, and population in which the labor force associated with the population estimate is consistent with the employment estimate from the economic submodel.

Although BREAM has this same general structure, the three core submodels have been refined extensively. In addition, BREAM includes two other submodels. A construction worker submodel has been added to analyze the construction period impacts of large projects whose labor requirements exceed local supply. This submodel deals explicitly with assumptions concerning the mover/nonmover composition of the work force and the community allocation of the movers. A community allocation submodel has also been added to BREAM. This submodel takes county-level population estimates and allocates them to communities (or rural areas) within a county.

b. Strengths

BREAM provides a mechanical, empirically-based method of producing consistent projections of population, employment, and income, and is, therefore, a means to evaluate the objective results that would occur from different assumptions about instrumental economic and demographic variables. The model's structure employs a relatively detailed demographic structure, a straightforward economic framework, and a specific accounting for many of the real world variables that are most subject to change, namely, vital rates, migration, labor force participation, and the spatial interaction among different-sized economies. The result is a tool that can be used for impact assessment in various ways in places with a variety of economic and demographic structures.

c. Limitations

There are limitations of the model that affect the way in which impacts are assessed. These aspects may be considered inherent weaknesses, although they do not necessarily detract from the stated purposes of the model. The user must be cognizant of the functions that BREAM cannot effectively fulfill. Awareness of these limitations aids the realistic interpretation of the model's output.

(1) Leads and Lags

A problem may be encountered using BREAM in an assessment or planning study in which a large basic employment change occurs over a short period of time. The model's structure presupposes that the exogenous changes in basic employment and induced effects occur concurrently. Because the model deals with "annual averages," it is difficult for the methodology to sort out peak employment on any basis other than an annual one. Similarly, the induced changes do not appear until the basic employment has been introduced. Real world situations unfortunately may not correspond to these assumptions. Peak employment may be seasonal, and the effects of such a pattern would not be well represented by a series of average annual data. Additionally, induced employment may not be concurrent with the basic employment stimulus. There is evidence that induced construction activity may anticipate project initiation and that induced employment activity may have a threshold limit that dictates internal changes in labor market structure (changes in working hours or skill classes) prior to larger adjustments via changed unemployment or migration. The result is that the implied multipliers may either overestimate the actual induced effects or may incorrectly time the anticipated annual changes. This has been a problem in very small areas that have experienced a large basic employment change that was relatively short-lived.

(2) Interindustry Purchases

The economic submodel of BREAM has an economic base foundation and, as such, has no explicit consideration of interdustry purchases. This may or may not be a problem depending on the extent of local purchases of intermediate goods in an area. If the indirect basic activity related to a project is substantial, the BREAM data must be supplemented with some estimate of those effects. Existing data on interindustry transactions must, nonetheless, be carefully reviewed to account for important forward or backward linkages and to identify any indirect basic employment associated with the proposed project. These data must then be included with the direct basic employment inputs to BREAM.

(3) Labor Force Participation

As BREAM is currently configured, the labor market submodel evaluates the consistency of labor supply projections with labor demand implied by the projected economic activity in the area. Labor market imbalances are assumed to initiate adjustments, the principal mechanism being employment-related migration. Accordingly, the model ignores any structural changes that may occur in response to labor market imbalance. A primary change that is not explicitly accounted for is the likelihood that labor force participation rates may fluctuate with economic opportunity. Although the explicit mechanism of BREAM may work well for skilled occupations that depend substantially on imported labor under most development alternatives, the responsiveness (of local labor markets) under these circumstances is probably understated. Ideally, labor force participation rates should be treated endogenously as a function of both demographic and economic characteristics. Unfortunately, not enough is yet known to make participation rates endogenous, particularly for rural areas in which a significant amount of the economic expansion is occurring. The user should, therefore, closely examine the labor force participation data being used for a BREAM run and evaluate the probable effects of the proposed action on those rates.

(4) Application to Large, Urban Areas

One shortcoming of BREAM has been identified in applications to large urban areas. The relatively simple (as opposed to a complex multisector, input-output model) economic base framework does not readily lend itself to analysis of complex economies, especially if a proposed plan is a small contribution to total economic activity. Additionally, the labor market imbalance issue described above is particularly germane to large urban areas, and the explicit evaluation of construction worker

behavior can be meaningless for areas with thousands of existing construction employees. Although BREAM has been used for analysis in large urban areas, its comparative advantage lies in its ability to assess changes in smaller regions.

(5) Wages, Productivity, and the Gammas

The final qualifying remarks about BREAM concern the gammas (ratio of non-basic employment to personal income) and the associated variables that present real wages and productivity adjustments. The concept of the gammas is appealing: there is a quantifiable relationship between income and induced economic activity. At one point in time, this relationship is easily computed. The difficult job remains to say something about how the gammas will change through time. As the model is currently configured, the gammas and real wages are adjusted for forecast changes in productivity. These adjustments, however, may not accurately reflect the short-run pattern of wages and employment for some sectors in a given area. The probable extent of the differences between the model's forecast of the changes in gammas and those that actually occur is unknown, although the differences should be insignificant.

d. Data Requirements

The data requirements for BREAM are, for the most part, secondary and consist of state and local data. Examples of some specific data requirements are employment, age-sex distributions, vital rates, base year populations, income and age-and-sex-specific labor force participation rates.

3. ACCESSIBILITY:

This model is currently operational on Mountain West's computer, as well as the Bureau of Reclamation's computer located at the Denver Federal Center.

4. APPLICABILITY:

BREAM has been used for environmental assessment work.

5. EXAMPLES OF WHERE AND HOW TECHNIQUES HAVE BEEN USED:

BREAM was recently used to assess the economic impacts of a proposed coal synthetic gasification plan in Wyoming.

6. SOURCE/CONTACTS:

A Technical Description and Users Guide is available through Mountain West. Contact Jim Chalmers, Mountain West Research, Incorporated, 1270 E. Broadway, Suite 212, Tempe, Arizona 85282.

1. NAME: Utah Process Economic and Demographic Impact Model (UPED)

2. DESCRIPTION:

a. General Description

The UPED Model is an economic and demographic systems simulation impact model. It is designed to accept user-identified assumptions regarding critical aspects of the future path of economic and demographic parameters for a specific geographic area and then produce a comprehensive and detailed projection of future economic and demographic variables. Examples of the assumptions provided by the user are as follows: future birth and survival rates, nonemployment related migration, labor force participation, multiple job holding, employment which produces goods and services for export, economic structure required for the production and importation of goods and services for export, and the economic structure necessary for production and importation of goods and services for local consumption.

The underlying theoretical precept of UPED is the well established economic base concept which holds that, for all but the largest (national-continental) regions, one of the primary determinants of the level of economic activity, and consequently of population size, is the amount of goods and services produced for export to other areas. According to the economic base concept, variations of basic (export) sector employment produce variations in the number of households deriving their income from these sectors. These variations, in turn, produce variations in demand for goods and services produced locally for local consumption. Subsequently, these changes produce further variations in population and in household incomes, which generates a "multiplied" change in local employment and population.

The economic base concept is combined in UPED with the three-component (births, deaths, migration) cohort survival population projection methodology. In each projection subperiod, the birth and death components of the population projection calculations are carried out with standard cohort aging, birthing, and surviving techniques. The nonemployment related part of the migration component is projected partly exogenously and partly as a function of local population. The projection of the economic opportunity related component of migration is controlled by the projected level of employment opportunity. This, in turn, is projected through UPED's formulation of the economic base concept which relates population size and composition to basic and population dependent employment opportunities.

The output of the model includes population by age and sex, households by age and sex of head, school age population by grade level and sex, labor force by age and sex, and employment by industry.

These variables can be projected thereby providing a likely baseline scenario of the future situation based on the behavioral changes and economic developments assumed most likely to occur. This baseline projection can then serve as a standard of comparison against which alternative future projections can be compared. In usual applications, the difference between a projection assuming a specified change in economic or demographic trends or conditions and the baseline projection will be identified as the impact of the specified change.

b. Strengths

The model is a systems simulation model in that its equational structure attempts to capture the complex casual interconnections between the size and composition of the population and level and composition of employment in an area. The model is also an impact model in that its logical structure and the structure of the implementing computer program permits the introduction of any number of alternative assumptions concerning future economic and/or demographic developments. For example, these alternatives may represent the occurrence or nonoccurrence of a major economic development or the continuation or decline of a current major industry. The model then calculates the difference made by such an event as compared to the case where the event is assumed not to occur. This difference is defined as the impact of the event. Similarly, demographic parameters can be varied to reflect, for example, assumed future increases or decreases in the native population and the model would produce projected variables resulting from such a change.

As a planning tool, this capacity to produce scenario-specific projections rather than a single "best guess" projection is an important strength of the UPED Model. It is never possible to know with certainty the future course of any area's economy. In small economies such as Utah's Multi-County Districts (MCDs), the quantitative impact of possible, but not certain, future economic developments can be extreme. Thus, contingency planning is an essential element of planning in such areas. Contingency planning requires comprehensive information about the economic and demographic consequences of each potential economic development and the routine ability to project such consequences of new potential developments as they are recognized. The UPED Model is designed as a tool to provide such information.

c. Limitations

UPED was designed to be used for a specific geographic area, thus a "best guess" or a projection is required to obtain the model parameters for areas not previously modeled.

The major limitation of the model is that it was designed for a large metropolitan area, and it is an extremely good indication of growth in a SMSA, but in a small rural area the model is weak since it was not designed to assess the limited sectors of a rural economy.

d. Data Requirements

Secondary and Primary

3. ACCESSIBILITY

The UPED manual and related data are available from the following sources:

(a) Utah State Planning Coordinators Office
State Capitol Building
Salt Lake City, Utah 84114

(b) Bureau of Economic and Business Research
401 BUO College of Business
University of Utah
Salt Lake City, Utah 84112

4. APPLICABILITY:

The purpose of the UPED Model is to project changes in economic activity and population based upon user-specified changes in the area's economic base and economic and demographic behavior patterns for a given market area. Therefore, the model would be useful in both the environmental assessments and the planning efforts.

5. WHERE OR HOW TECHNIQUES HAVE BEEN USED:

Report: Nevada-Utah MX Impact Area

Report: Economic and Demographic Imports of MX Deployment in Utah and Nevada (Construction Phase)

6. SOURCE/CONTACTS:

Rodger Weaver, Frank L. Hackman, Anthony S. Wilcox, T. Ross Reene, Bureau of Economic and Business Research, College of Business, University of Utah and Utah State Planning Coordinators Office, Salt Lake City, Utah - January, 1980.

1. NAME: The Social and Economic Assessment Model (SEAM)

2. DESCRIPTION

a. General Description

The SEAM modeling system employs a modified cohort-component (analogous to a cohort-survival) methodology to perform the demographic analyses and relies on economic base procedures for the economic assessment. Through these two human and economic resource components and the two fiscal-service components, SEAM is able to provide the following minimum output products to the user:

(1) Annual projections of population by age and sex;

(2) Annual direct employment requirements for most forms of energy extraction, combustion and conversion facilities;

(3) Annual estimates of indirect (secondary) employment requirements created by the presence of the new energy industrial facility;

(4) Annual projections of locally available basic and secondary workforce;

(5) Annual projections and characterizations of in-migrating worker households induced to the county by the new activity;

(6) Annual public service requirements of the new induced population; and

(7) Estimates of the annual public uses of providing these additional public services.

Through these output products and the variables comprised within the model, SEAM describes a matrix of social, economic and institutional adaptations wedded to an energy or industrial development. As a tool, SEAM exemplifies efforts to provide a more complete and accurate assessment of sociocultural and socioeconomic impacts associated with expanded and alternative energy/industrial development. It is not the energy/industrial development in isolation, but the marriage of that development to its host environment which results in either smooth or complicated adjustments to the forecasted changes.

b. Strengths

The Social and Economic Assessment Model (SEAM) is comprised of three interrelated submodels: the demographic projection submodel, the employment impact submodel, and the public cost submodel. SEAM is used to estimate the social and economic impacts due to energy/industrial developments. The demographic

projection submodel projects age- and sex-specific populations to the year 2000 at the county level. The employment impact submodel determines the manpower requirements (construction and operation, direct and indirect) and calculates the resulting population impacts. The public cost submodel estimates service and facility costs the impact county can expect to incur due to population increases. Assessments can be made for all counties in the contiguous 48 states except for Virginia and a small number of counties for which sufficient data has not been available.

The versatility of SEAM is enhanced by the fact that it does cover all regions of the continental United States (excluding Alaska and Virginia), and that its output may be aggregated from the county-level to the multi-county, state, regional, and national levels. Because of this geographic breadth, SEAM can be used to assess the impacts of the same type of facility (such as a nuclear power plant) sited in counties in Maine, California, Florida, or Washington, as well as virtually any of the states in between. SEAM contains data for and is applicable to more than 3,000 counties in the continental United States. As such, it is truly national in its geographic coverage.

SEAM output presents all data at the county level. Such county-level data may be aggregated over larger geographical units according to the desires of the user. A state planning official assessing the impacts on a state due to a number of new energy facilities, might sum appropriate SEAM output for all impacted counties in the state. Likewise, a regional commission might aggregate SEAM output over a number of states, while a national policy maker might perform the same function over a number of states, regions, or even over the entire country. Through such aggregation of county-level output, the users can determine aggregate impacts over the geographic unit most relevant for their purposes.

c. Limitations

SEAM provides a valuable, although by no means complete, assessment of the positive and negative impacts of a new development (or of an anticipated natural population increase) on an impacted county and its neighboring counties. The positive impacts may be measured in terms of the number of local resident and commuter workers who find new employment due to the construction and operation of the new facility, be they employed on the project workforce or in the secondary sector. Other positively related impacts not presently modeled by SEAM include the additional tax revenues accruing to local governments, the increased standards of living due to higher construction wages paid to previously under- or unemployed local residents, and the additional benefits produced by other new industries migrating to the area due to the newly-constructed facility.

Alternatively, one indicator of probably negative socioeconomic impact frequently used in interpreting SEAM is the incremental cost of public services per long-term community resident, required to meet the needs of the new population migrating to the area as a result of the new development. Several other measures of impact are possible and appropriate, depending on the case examined. The impact indicators are all originally derived from estimates of in-migrants (basic and secondary workers, and their dependents) necessary to construct and operate the facility. Additional negative impacts not measured by SEAM include such things as decreased community cohesiveness, neighborhood stability and housing availability due to the population growth, and streets and highways requirements.

d. Data Requirements

The importance of the impact assessment process to incorporate descriptions and projections of the existing environment, the proposed action and the proposed action in conjunction with the impacted environment is illustrated in Fig. 1. This figure, in conjunction with the narratives, describes the flow and actions necessary to properly assess impacts resulting from an energy/ industrial development activity. SEAM accounts for most of these steps either completely or only in the means available to a computer model. In Steps 1 and 2 (description of the existing environment and projections without the proposed action) SEAM provides the user with the principal socioeconomic characteristers of the county and its population together with the natural population and employment forecasts given existing trends. SEAM accounts for Step 3 (description of the proposed action) by indicating the basic and secondary employment requirements by construction and operation period. Step 4 (projections with the proposed action) is accomplished by simulating the energy/industrial development in the context of the existing county environment. The available workforce is contrasted with the employment requirements of the development. If the energy/industrial activity provides a greater number of jobs than can be filled by the local and non-local (commuting) labor force then in-migration results with the creation of new households, additional population, and the expanded demand for public and private services. SEAM does not perform Steps 5 and 6 (analysis of impacts and analysis of opportunities for mitigation and enhancement) but provides the user with all the tools, data and capabilities to perform an assessment, test the sensitivity of the results and evaluate potential impact mitigation opportunities.

3. ACCESSIBILITY

The public version of the social and economic assessment modeling system is now available upon request at the United States Department of Energy, Office of the Environment, Regional Impacts Division. Through their established communication and procurement procedures, access to the model can be accomplished either by means of purchasing a copy of the model on computer tape or by direct access.

If a user purchases a computer tape containing the model, its code and data, from either DOE or NTIS, the tape could be mounted on a compatible computer system, owned or leased by the user. This action would allow the user to access the model at their convenience but may be subject to considerable front-end and operating costs. These costs are associated with the adaption of the model to a system other than IBM (if required), establishment of access procedures, computer storage charges, system peculiarities of the computer being utilized, and finally, operating charges. Once the user has mounted and adapted SEAM to their own computer system, the interactive language associated with that system will dictate the access procedures.

4. APPLICABILITY AND EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

SEAM has been employed by a wide variety of users, for a number of different purposes, and covers a range of geographical units of analysis and regional settings. Past and current users have included county governments in such states as North Dakota, Indiana, Missouri, and West Virginia and those in the Tennessee-Tomolgbee Corridor; the state governments of New Mexico, Illinois, and New Hampshire; the Appalachia Regional Commission, and the federal agencies of the Department of Energy Nuclear Regulatory Commission and the Army Corps of Engineers. These and other users have applied SEAM for three main purposes. First, SEAM has been used to generate county-level impact assessments for various types of projects. The State of New Hampshire used SEAM, for example, in analyzing the local impact of the Seabrook Nuclear facility. SEAM also was used to assess the impacts of coal gasification plants on counties in Missouri (the Council of Governments of Sullivan and Boone Counties) and North Dakota (Mercer County).

A second application of SEAM involves policy and sensitivity analyses to determine either the impacts of a legislative act or government program, the various impacts emanating from different policies, or both. Policy analysis of the National Energy Act, for example, included projections of the impacts of increased coal mining and use for over 200 counties. The Regional Issues Identification and Assessment Projection (RIIA) conducted for the Department of Energy used projections of the impacts of new oil, gas, nuclear, and coal facilities on all U. S. counties in which they may be

constructed. In addition to this type of policy analysis, SEAM has been used in sensitivity analyses to determine the significance of select technology and siting patterns on the impacts resulting from coal-based liquid synthetic fuels plants (Wermette, 1980), and in evaluating the methods of eliminating potential socioeconomic impacts of coal development (Santini, 1978). A related use of SEAM has been to project the changes in the aggregate levels of impacts on rural communities from adjustments to the type and siting pattern of electric facilities (Santini, 1979).

The final use of SEAM has been as a data resource. The State Planning Commission of North Dakota requested SEAM population projections for all counties in the state. Other states, such as California, have used SEAM population projections in fiscal planning. Used as a data resource, impact assessment model, or policy analysis and assessment method, SEAM is versatile for the planner, policy maker, or analyst at all levels of government.

6. SOURCE/CONTACTS

User manuals are available and for further information contact:

David W. South or Mark J. Brager
Integrated Assessments and Policy Evaluations Group
Energy and Environmental Systems Division
Argonne National Laboratory
Argonne, IL 60439

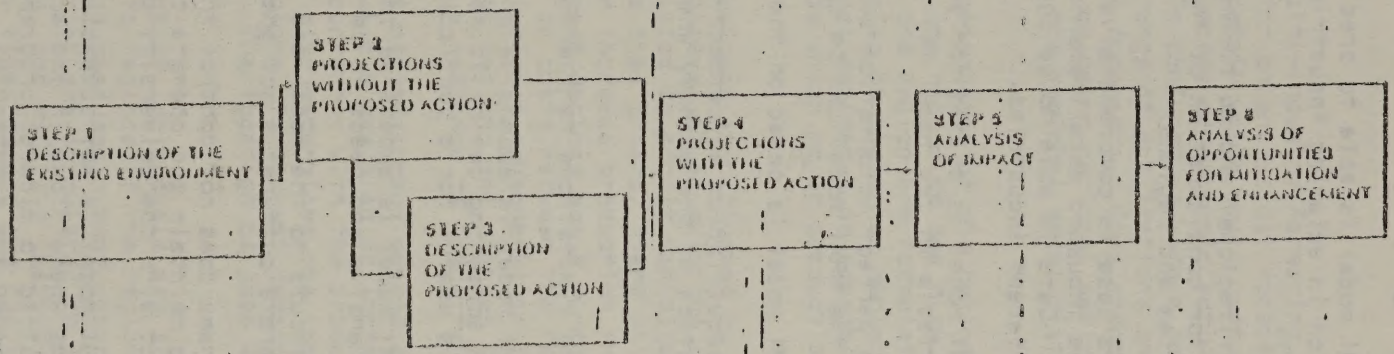

Fig. 1 Steps in the Impact Assessment Process

Source: Western Coal Planning Project, 1979

a. Strengths

The major strengths of the MRMI model may be summarized as follows:

(1) The MRMI model is able to predict new economic activity, economic expansion in existing industries, and the decline of economic activity.

(2) The multiregional and multi-industrial nature of the model allows for consideration of the economic relationships between industries and regions.

(3) The data base is comprehensive in nature. It includes more than one thousand data items for each county in the United States. Data is able to be aggregated by different counties and different industries.

(4) The MRMI model is suited for sensitivity and impact analyses. Any variable in the model may be predetermined.

(5) As more perfect information becomes available, relationships within the MRMI model can be changed.

(6) The MRMI model is based on the sound theory of locational rents.

(7) The disequilibrium adjustment of the MRMI model allows the examination of the economy when it is not in equilibrium.

b. Limitations

The following limitations to the MRMI model have been identified:

(1) The MRMI model is expensive and not always cost effective to run. A screening device is needed to determine whether the model is useful for a particular problem being studied.

(2) The MRMI model is expensive to maintain. The data base is comprehensive and needs to be updated frequently to be useful.

(3) After inputs to the model are specified, the time still needed to generate outputs is not short.

(4) The Bureau does not control the model. At present, it is not able to maintain and operate the model itself. Instead, a contract with the University of Maryland is used.

(5) The MRMI model is not suitable for applications in resource programs where flows in the economy are small. The model is more suited to mineral programs, for example, where flows in the economy are substantial.

(6) Some persons have argued that the MRMI model is complex and difficult to understand. When results have deviated from expectations, persons have had difficulty understanding why in order for adjustments to be made.

1. NAME: Multiregional, Multi-Industry Forecasting Model

2. DESCRIPTION:

The Multiregional, Multi-Industry Forecasting Model (MRMI) was constructed to address the need for an analytical/forecasting model with sufficient regional industrial detail which could capture the inter-regional and interindustry dependencies of economic activities. The MRMI model is designed to be used in conjunction with a national forecasting model in order to expand the range of applications and to ensure consistency between national and regional forecasts. Consistency of regional and national variables is ensured by using national estimates of economic vairables as controls and letting the regional model distribute the national variables to the regions.

To capture the interdependence of the regional activities the model is applied to more than one region at one time. Equations explaining the economic behavior in one region are formulated to depend on variables describing the economies of the other regions. The equations used to distribute the national estimates of economic variables to the regions reflect the process by which major production and household location decisions are made.

It is assumed that business is motivated by profit and the decisions to change the production level at an existing site or to start production at new locations are related to profit maximization motives. If one location yields higher profits than others, there will be an incentive for the industry to locate or increase production in that location. Differences in profitability between regions are a function of differences in production and transportation costs between the regions. The MRMI model calculates the relative cost advantages or disadvantages and moves industries into low-cost regions and changes the regional pattern of production/demand as a response to industry relocation.

The regional patterns of investment depend on production decisions. A firm's decision to build a new plan or increase production capabity in a region is made concurrently with the production decision. Thus, the location of industry also determines the location of investment demand. In the MRMI model regional investment demand is related to changes in regional production. The location of jobs by place of work is also related to production.

The location decisions of individuals are similar to those of business. Individuals migrate to regions if the regions have low unemployment rates, high wages, and good employment opportunities. The MRMI equations that forecast population are formulated to include changes in employment by place of residence, and relative unemployment in the region. The estimates of regional final demand are derived endogenously reflecting regional demand by both consumers and industries.

The MRMI model is dynamic and recursive forecasting on an annual basis. Data are used to make the first year's forecasts which then are used as data to make the second year's forecast and so on.

(7) The sectors specified in the model do not always conform to the resource sectors under examination in the Bureau.

(8) The MRMI model is unable to estimate impacts below the county level.

c. Data Requirements

Data for the MRMI model are collected by county. The model can be calibrated for counties or any regional delineation which is a group of counties. The model is highly disaggregated. There are currently four operating versions of the model for different regional delineations: counties, the Bureau of Economic Analysis (BEA) economic areas, standard metropolitan statistical areas SMSAs) and rest-of-economic areas, and the Department of Transportation (DOT) transportation zones. As the following table implies, the cost of updating the comprehensive data base is high in terms of dollars, time, and work-months.

Classification of Data Used in
Multiregional, Multi-Industry Forecasting Model

Regional Data Item	Number of Sectors New Version 1970-1974
Industry output	104
Industry employment (jobs)	108
Industry earnings	108
Equipment purchases	73
Type of Construction	26
General government	24
Defense expenditures	104
Personal consumer expenditures	104
Foreign exports	104
Foreign imports	106
Population by age and race	8
Births	2
Deaths	8
Multijob holders	1
Net commuters	1
Civilian persons employed	1
Civilian labor force	1
Civilian unemployment	1
Personal income	4
Value of land	1
Marginal transport cost of shipping output	68
Marginal transport cost of obtaining inputs	68
Total demand	104
	1,129

3. ACCESSIBILITY:

The MRMI model has been developed to a large degree by Dr. Curtis Harris of the University of Maryland. The model is maintained by the Division of Behavioral and Social Sciences of the Bureau of Business and Economic Research at the University of Maryland. Presently, the Bureau does not control the model. It has expended significant funds in the model's development and maintenance and has gained access to the model by entering into contracts directly with the University of Maryland. Future access to the model will be dependent upon additional contracting efforts with the University of Maryland. The Bureau does not presently have the capability to acquire, maintain, and operate the model. As a result, long turn around times and other limitations to the model's use are expected to remain.

4. APPLICABILITY:

The MRMI model can be best used to study the impacts of resource programs that involve large dollar flows in the economy. The model is particularly suited to problems involving a large area including many states and many areas. It is not suited to examine impacts below the county level. Sensitivity analysis is particularly effective because the variables used in the MRMI can be specified exogenously where desired. When using the MRMI model, a screening technique should be used to determine whether the model is indeed an appropriate tool to use for the examination of a given problem.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

The following is a list of references which provide examples of where and how the MRMI has been used:

(1) Almon, Clopper, Jr., Margaret B. Buckler, Lawrence M. Horwitz, and Thomas C. Reimbold. 1985: Interindustry Forecasts of the Economy. Lexington, Massachusetts: Lexington Books, Heath, 1974.

(2) Bender, Filmore, et al. Solar Energy Applications in Agriculture: Potential, Research Needs and Adoption Strategies. Report to Agricultural Resource Service, U.S. Department of Agriculture, January, 1976.

(3) Cumberland, John H. and Alan J. Krupnick. "An Economic-Environmental Planning Manual for Counties, States, and Metropolitan Areas." Paper presented at the annual meetings of the Regional Science Association, Philadelphia, Pennsylvania, November, 1977.

(4) Connelly, William and Ali Parhizgari. "Estimating the Regional Impact of Energy Shortages." Paper presented at the International Regional Science Conference on Energy and Environment, Louvain, Belgium, May, 1975.

(5) Dun, Edgar. The Location of Agricultural Production. Gainsville: University of Florida Press, 1954.

(6) Grigalunas, Thomas. Offshore Petroleum and New England, Marine Technical Report No. 39. University of Rhode Island, Kingston, Rhode Island, 1975.

(7) Harris, Curtis C., Jr. The Urban Economies, 1981: A Multiregional, Multi-Industry Forecasting Model. Lexington, Mass.: Heath, 1973.

(8) ------. Regional Economic Effects of Alternative Highway Systems. Cambridge, Massachusetts: Ballinger, 1974.

(9) ------. "Report on the Impact of Interstate 84 Between Providence and Hartford." Prepared for Close, Jensen and Miller, Wethersfield, Connecticut, March, 1976.

(10) ------ and Merhzad Nadji. "Derivation of Regional Shadow Prices." Working Paper 78-19, University of Maryland, College Park, Maryland, October, 1978.

(11) King, A. Thomas. "Expenditure Forecasting Model for Local Governments." Bureau of Business and Economic Research, University of Maryland, 1978.

(12) ------. "A Revenue Forecasting Model for State and Local Governments." Bureau of Business and Economic Research, University of Maryland, 1977.

(13) Krutilla, John and Anthony Fisher. Economic and Fiscal Impacts of Coal Development, Northern Great Plains. Baltimore: John Hopkins University Press, 1978.

(14) National Planning Association. "An Evaluation of the Economic Impact Project of Public Employment Program." Report to the U.S. Department of Labor, Manpower Administration, 1974.

(15) Reinfeld, Kenneth and Francis Callahan. Economic Study of the Possible Impacts of a Potential Baltimore Canyon Sale. Technical Paper No. 1, Bureau of Land Management, U.S. Department of the Interior, December, 1975.

(16) Southeast Michigan Council of Governments. Report, 1977.

(17) Stevens, Benjamin. "Linear Programming and Location, Rent," Journal of Regional Science, 3 (1961), 15-26.

(18) Transportation and Communications as Complementary Forces in Rural Development. New Rural Society Project, Fairfield University, Fairfield, Connecticut, June, 1976.

6. SOURCE/CONTACT

The references listed in the previous section provide the major source of documentation for the MRMI model. An update of the documentation for the current model is contained in:

Nadji, Mehrzad, Curtis C. Harris and Virginia McConnell, "MRMI Model Methods, Standards, and Assumptions." Technical Memorandum Number 1, Regional Forecasting Project, Bureau of Business and Economic Research, University of Maryland, August 15, 1981.

The primary contact for the MRMI model is:

Kenneth Reinfeld
Economist
Office of Policy Analysis
Department of the Interior
18th and C Streets, NW
Washington, D.C. 20240
(202) 343-8875

1. NAME: Fiscal Impacts Model

2. DESCRIPTION:

a. General Description

This model generates the fiscal impacts associated with coal mining or coal fired electrical generating plants in either Montana or Wyoming. Output from the model includes: (1) taxes paid by the coal mine or power plant; (2) taxes paid by the workers; (3) property taxes paid by the mine or power plant; (4) school district taxes paid by the mine or power plant; and (5) taxes paid by the ancillary employees.

b. Strengths

It quickly quantifies a number of specific fiscal items that will be impacted by coal mining or a coal fired electrical generating plant. This provides the analyst with the flexibility to efficiently analyze a number of different development scenarios.

c. Limitations

The program must be updated by a programmer familiar with the model every time the tax laws change. Also, the program is not written in an interactive mode so it is not user oriented. It can, however, be accessed and run from a remote terminal with some basic instruction on card manipulation and the text editor.

d. Data Requirements

The following represent the data that is required to run the model:

(1) Acres of disturbed land;

(2) Assessed land value;

(3) Annual production in tons;

(4) Employees directly employed by the project;

(5) Capital requirements;

(6) Local mine or plant purchases;

(7) Assessed value of the equipment;

(8) Price of the output;

(9) Operating costs;

(10) Required returns;

(11) Mine or plant employment by income group;

(12) State millage;

(13) School millage;

(14) County millage;

(15) City millage;

(16) Probability of company purchases occurring in the county;

(17) Probability of residing in the city;

(18) Ratio of car/adult;

(19) Percentage of rural population;

(20) Percentage of consumer purchases in the county;

(21) Employment multiplier;

(22) Percent ancillary employment;

(23) Percentage of owner occupied, mobile homes and rental units;

(24) Ratio of adults/worker;

(25) Ratio of children/worker for grade school, junior high and high school;

(26) County assessed valuation before the project;

(27) Enrollment: grade school, junior high and high school;

(28) Average family size;

3. ACCESSIBILITY:

This model is operational on the University of Minnesota's computer.

4. APPLICABILITY:

The model could be used for environmental assessment work as well as the Bureau Planning System.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

The model has been used in a coal environmental impact statement.

6. SOURCE/CONTACTS:

User manuals are not currently available. For information on the model contact Tom Stinson, University of Minnesota,

DEMOGRAPHIC AND ALLOCATION MODELS

1. NAME: BLM/Cohort-Survival Model

2. DESCRIPTION:

a. General Description:

This model is a cohort-survival simulation which uses permanent files containing state population, death and birth data to calculate age, cohort birth and death rates. County or regional population-age distributions by race and sex are entered by the operator and the program will extrapolate "natural" population change by age class, race, and sex for as many years into the future as desired.

b. Strengths

This model is flexible and can accept new information as it becomes available. Although state data for 1970 are currently stored in available permanent files which may be accessed through the program by the operator, state population, birth, and death data may be updated upon receipt of new information.

The model has four "paths" which can be followed at the option of the operator. Path one presupposes an existing data file for the state which contains the study region. The operator then enters the county or substate regional data and the program extrapolates the population distribution into the future. Path one should be selected by the operator if a permanent file exists for the desired study region. The following list represents the files that are available:

LIST OF 1970 CENSUS DATA PERMANENT FILES AVAILABLE FOR COHORT

File Name	State Name
1. ALAB	Alabama
2. ARIZ	Arizona
3. CALIF	California
4. COLORADO	Colorado
5. IDAHO	Idaho
6. MONTA	Montana
7. NEMEX	New Mexico
8. NEVAD	Nevada
9. OREGON	Oregon
10. UTAH	Utah
11. WASH	Washington
12. WYOM	Wyoming

Path number two allows the operator to enter data for temporary use to estimate birth and death rates. (Assuming that the available state data are not the best source.) Once the program is terminated under path two, however, all data are lost.

c. Limitations:

The data required for the model is census data, and therefore the currency of the data is dependent upon the latest census information which can be as much as ten years old.

d. Data Requirements:

The data requirements for the model are derived from secondary sources such as the Bureau of Census. The specific elements are state population, death and birth data, and age by race and sex.

3. ACCESSIBILITY: (Largely computer-related)

This model is operational on the Bureau of Land Management's computer located at the Denver Service Center.

4. APPLICABILITY:

This model can be used to balance the natural growth against the demand for new labor to determine immigration associated with any major land management decision.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

The cohort-survival model has been used to determine the natural growth for the Powder River Coal Environmental Impact Statement.

6. SOURCE/CONTACTS:

A users manual is available. Contact Roy L. Allen, Wyoming State Economist, P. O. Box 1828, Cheyenne, Wyoming 82001, FTS 328-2358.

1. NAME: Gravity Model

2. DESCRIPTION:

a. General Description

The Gravity Model is intended to provide a mechanical method for distributing the anticipated influx of people to various impacted communities.

b. Strengths

This model offers a quick first approximation of the distributional effects of those people who are relocating in an area that is experiencing rapid growth due to, for example, coal development.

c. Limitations

One must keep in mind that the Gravity Model in its present form produces a very rough approximation of the distribution effects accompanying rapid growth. This means that the analyst must carefully scrutinize the results from the model and recognize that they may or may not represent a reasonable distribution based upon a subjective analysis.

d. Data Requirements

The data requirements are as follows:

(1) Population of the impacted communities.

(2) Distance from the mine or plant to the impacted community measured in minutes.

(3) Number of employees at the mine or plant.

(4) Additional population due to the mine or plant.

3. ACCESSIBILITY:

This model is currently operational on the Bureau of Land Management's computer located in the Denver Service Center.

4. APPLICABILITY:

The Gravity Model can be used to provide a first approximation of distributional impacts from inmigration.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

The Gravity Model was used for distributing the population for the Colorado portion of the Green River-Hams Fork Coal Environmental Impact Statement.

6. SOURCE/CONTACTS:

A users manual is not available but the model is user oriented and for the most part self-explanatory. For further information contact Roy L. Allen, Wyoming State Economist, P.O. Box 1828, Cheyenne, Wyoming 82001, FTS 328-2358.

MISCELLANEOUS

1. NAME: Coal Resource Economic Evaluation (CREV)

2. DESCRIPTION

a. General Description

The purpose of the CREV (DCF) program is to calculate an estimated net present value to the lessee of tracts of federal coal lands offered for competitive sale. It can also be used to value lease modifications, exchanges and preference right lease applications. The program has been coded to reflect the different mining situations which may arise and embodies current economic and geological principles. The life of a mine has been divided into four phases with appropriate expenditures allowed in each phase. These phases are as follows:

(1) Predevelopment phase - relates to all activities required to obtain acquisition of a tract for mining.

(2) Development - pertains to that time period after tract acquisition and prior to production of coal.

(3) Production - normally the longest period in the mine life and refers to the recovery of the mineral resource.

(4) Post-production - this phase covers the salvage and recovery of any assets remaining and the reclamation of the land.

Using the above periods for the mine life, the program uses cost and price data that are input for each period to calculate a discounted net worth for a particular mine scenario. The program also takes into account such items as advance royalty, black-lung fee, bonus, reclamation fees, and taxes. The model can be run with or without inflation. Four methods of depreciation are available for user option with a fifth presently being incorporated to reflect the principles of the Economic Recovery Act of 1981.

The structure and program flow of the CREV model are documented in the code and a flow chart has been developed for users. The length of the program is approximately 4,000 lines of executable code and sections can be readily identifiable for the location and values of certain parameters and calculations.

The output from the CREV model is self-explanatory and provides a considerable amount of intermediate and final data to analyze.

b. Strengths

The major strengths of the CREV model may be summarized as follows:

(1) Inputs to the CREV model are scalars or vectors. Each scalar can be predetermined and changed independently of other scalars. The vector inputs can also be predetermined for a range of years either for a particular constant value or different values in different years. This feature of the program makes it more flexible than most DCF programs.

(2) The DCF can be run interactively or in an absentee mode.

(3) An updated version now exists to reflect the principles of the Economic Recovery Act of 1981.

(4) A sensitivity analysis can be made with each run.

(5) A flow chart and mathematical description of the equations used in the DCF now exists.

(6) Output is printed under column headings and each row represents a year of operation of a mine.

(7) The CREV model is inexpensive to run and store on the MULTICS computer.

(8) The model has an option for bonus depletion.

c. Limitations

The following limitations to the CREV model have been identified:

(1) The CREV model was designed for coal resource evaluations, but through program modifications it can be used for other mineral evaluations.

(2) The sum of the input parameters for the predevelopment and development years must not exceed 10 at the present time. The production years for a mine must not exceed 60, and the post-production period must not exceed 10 years. This will give a project life span of a mine a maximum of 80 years.

(3) No mining simulation exists at the present time, thus some mine engineering expertise is required to develop the input.

(4) No Monte Carlo simulation exists for determining input parameters. However, this avoids the higher cost of running such a program.

d. Data Requirements

A sample data set exists for input to the CREV model. If any or all inputs are subject to changes, which is usually the case, a user can enter a text editor and make changes with a small amount of effort and time. Guidelines do exist so that a user could develop an input data base from scratch. A glossary does exist for definition of input parameters and their limits. At the present time, there are approximately 60 different variables to choose for input to the DCF program. This will give a user a wide range of options from which to select to represent the actual situation of a mine. If a particular input is not desired, or applicable in any situation, it can be zeroed out or ignored completely by deleting it from the list of inputs.

3. ACCESSIBILITY

Presently, the CREV model resides on the Denver and Resont MULTICS Computer. A designated person from each region has access to each computer to execute the CREV program, however, only certain personnel have access to permanently change or modify it. Any problem developed with the execution of the DCF program can be resolved by having another user execute the same program and see if he or she can determine the problem.

4. APPLICABILITY

The CREV model was designed with the assumption that a surface coal mining operation will be conducted by a Taxable Corporation in a profit making position. It is also assumed that the bonus is equal to the final value which results in zero net present worth to the lessee.

The model was designed for calculating present value for leases of strippable coal deposits but can be used for underground coal and other types of mineral commodities. Annual income and royalty streams in either constant (real) or nominal dollars can be calculated.

5. EXAMPLES OF HOW OR WHERE TECHNIQUES HAVE BEEN USED

The model is used primarily to obtain an estimate of the fair market value of specific tracts for comparison with the high bids received in lease sales. This estimate is used for consideration in the decision to accept or reject the high bids for the leases. Other uses of the model are (a) for comparing the value of tracts being exchanged, (b) to determine if applicants for preference right leases have discovered commercial deposits of coal, and (c) for evaluating requests for royalty reductions. In the past, all coal tracts for lease were offered with a minimum acceptable bid (MAB) of $25 per acre, but high bids above this amount might be rejected based in part on the estimated present value from the model.

6. SOURCE/CONTACT

The primary contact for the CREV Model is:

Erick V. Kaarlela
Chief, Branch of Economic Evaluation
Onshore Minerals Regulation
Conservation Division
U.S. Geological Survey
12201 Sunrise Valley Drive
Mail Stop 634, National Center
Reston, Virginia 22092
(703) 860-7531

1. NAME: Coal Transportation Model, U.S. Geological Survey

2. DESCRIPTION:

a. General Description

The model is designed to determine a set of optimal national coal distribution patterns given a set of constraints which include the supply and demand for coal, air quality requirements, and transport mode restrictions. The solution to the model contains a forecast of a least cost national distribution of coal for a given year. The primary use of the model is to examine the national and regional economic impacts of alternative federal policies.

The transportation model is a linear program that minimizes the cost of inter-regional coal flows for the utility, metallurgical, and export markets. The objective function consists of the sum of f.o.b. (free on board) coal mine price, transport rate, and the cost of complying with current EPA scrubbing regulations. There are five types of constraints: (1) a demand forecast for each market is met, (2) a supply availability and limitation distinguished between surface and underground resources for each region, (3) allowable limits for total sulfur emissions, (4) a total tonnage capacity restriction at river locks and a distance restriction on transmission of mine-mouth power generation, (5) existing coal contracts are retained and are not subject to optimization.

The model contains four modes of transportation: (1) mixed freight rail which connects all origins and destinations, (2) unit train which connects all supply routes west of the Mississippi River with demand routes west of the river and selected demand centers east of the river, (3) barge which connects all river docks along coal routes on navigable waterways, and (4) electricity generation which connects specific origins to destinations by high voltage transmission lines. The transportation rates for both types of rail and barge traffic are derived from multiple regression equations based on the number of shipments between origins and destination pairs, annual tonnage shipped, distance, intransit delay, shipment size, and dummy variables for competing modes of transportation. The transportation cost for mine mouth power generation for electric power transmission is derived from an accepted distance algorithm. This mode of transportation is limited to a distance of 350 miles due to quickly rising marginal costs after this distance. Slurry pipelines were not included because they are not in general use. However, this transport mode can be added and has been included in one of the previous applications.

The model contains three types of utility demand, where each type of demand reflects a different scrubbing requirement which represents sequential changes in air quality regulations. The first category of demand is fixed by contract for a base year of 1975. That demand is neither subject to optimization nor constrained by sulfur emission scrubbing restriction. At that time, each state had a published standard defined as a state implementation plan (SIP).

These standards never have been fully enforced. The second category is demand for electric power plants that were under construction prior to September 1978. This demand category's sulfur constraint either can be satisfied by the SIP standard with unscrubbed low sulfur coal, or by conformance with current EPA scrubbing requirements. The third category of demand contains a sulfur constraint that requires removal of 70-90 percent of sulfur as long as total emissions are less than 0.6 pounds SO2 per million BTU or remove 90 percent of sulfur and emit less than 1.2 pounds SO2 per million BTU.

b. Strengths

(1) The user is not constrained to a fixed number of regions or a fixed region size. The raw data are collected on a county basis and the user is free to group as many or as few counties into model demand and supply regions as suit his purpose. In that way, the model can be used to analyze the effect of a proposed policy on an area as small as a county or as large as the entire nation.

(2) The model uses observed selling prices in lieu of engineering mining costs in the objective function. The cost estimates that are obtained from simulating mining operations are extremely sensitive to assumptions about mine size. Since mine sizes can vary between less than 1 million tons per year and over 20 million tons per year in new multiple pit operations, the estimates for extraction cost per ton would have enormous variation. Therefore, this model uses Department of Energy data on average selling price per ton in each county, distinguished between surface and underground.

(3) The model is designed for easy sensitivity testing of input variables. That testing can take the form of supply, demand, environmental regulations or relative transportation costs between regions.

(4) The model includes mixed freight rail as well as unit trains as a transportation mode, recognizing that unit trains will not carry all of the railroad traffic.

c. Limitations

(1) Only BTU and sulfur and not other trace elements are used to categorize coal quality. Since individual power plants are not modeled, the effect of trace elements on boiler efficiency is assumed to be insignificant.

(2) Areas covering several counties are assumed to have the same BTU and sulfur content of the weighted average of the component counties. This approach is the best available since the data are not available to distinguish among the many coal types.

(3) Supply curves are assumed to be horizontal at a given price up to 1/25 of the resource capacity. At that point they are vertical. This problem may not be as critical since some of our initial results indicated that those curves are virtually flat over wide ranges of production.

d. Data Requirement

(1) Average BTU and sulfur content for each potential county.
(2) Coal demand (in quads) for each county.
(3) Air quality restrictions in each county.
(4) Capacity restrictions for inland waterways.
(5) A definition of counties that comprise the supply and demand regions.

3. ACCESSIBILITY:

The model is available at the U.S. Geological Survey. However, resource limitations may preclude extensive support to potential users.

4. APPLICABILITY:

The model is a tool that is best applied to analyze the regional impacts of a proposed government action. Since the user is free to define regions in whatever pattern suits his analysis, the inquiries can be quite specific.

5. EXAMPLES OF WHERE OR HOW TECHNIQUES HAVE BEEN USED:

Office of Surface Mining - Economic analysis of unsuitability petitions (Alton, Utah; Tongue River, Montana).

Department of the Interior (Secretary's Offices) - Cost of alternative leasing policies.

- Costs of alternative definitions of the amendments to the Clean Air Act.

- State and regional production levels for alternative leasing scenarios.

Corps of Engineers - Analysis of the economic viability of building a canal in Eastern Kentucky for the purpose of transporting coal.

Department of Justice - Analysis of the competitiveness of transportation from the Powder River Basin.

6. SOURCE/CONTACTS:

Richard Bernknopf, Leonard Gordon
U.S. Geological Survey
Mail Stop 105
Reston, Virginia 22092
703/860-7437

1. NAME: Linear Programming (Ranch Budget Analysis and Other BLM Uses in Wyoming)

2. DESCRIPTION:

a. General Description

(1) Linear programming is a mathematical optimization technique (usually performed on a digital computer) in which a set of decision variables are combined to minimize or maximize a specific objective function subject to a set of linear constraints.

(2) Mathematically linear programming is generally defined as follows:

Maximize $z = \sum_{j=1}^{n} cx_j$

Subject to: $\sum_{i=1}^{m} a_{ij}x_j \leq, =, \geq b_i \quad j = 1,2,3, \ldots n$

$x_j \geq 0$

Where:
- z is net revenue.
- x_j is the decision variable or activity.
- c_j is the cost or revenue from performing one unit of activity (x_j).
- a_{ij} is the coefficient for activity (x_j) for constraint (i).
- b_i is the right-hand side value of the linear constraint (i).

b. Strengths:

(1) Adaptable to any optimization problem which can be structured around a linear objective function and constraints.

(2) A wide range of prices, costs, and management alternatives can be evaluated with a minimal amount of data manipulation.

(3) Flexibility exists to allow for model updating as new data becomes available.

(4) Linear programming techniques are well documented and many usable models already exist.

c. Limitations:

(1) Assumes additivity and divisibility of resources (unless integer or binary linear programming is utilized).

(2) Assumes constant returns to scale unless provisions are made for segmentation of constraints or surrogate constraints are used.

(3) Linear programming is static in nature.

d. Data Requirements:

(1) Linear programming requires a specific objective to be optimized.

(2) Constraints which affect the objective function must be identified and set, to restrict the solution within the bounds of the problem.

(3) Coefficients must be derived for each variable's interaction with the objective function and constraints.

3. ACCESSIBILITY: (Computer Related)

a. Bureau of Land Management:

(1) The Mathematical Programming System (MPS) and other time-sharing linear programming packages are available at BLM offices throughout Wyoming, through time-sharing terminals connecting with the Denver Service Center (DSC) Honeywell 6600 Computer.

(2) The MPS linear program is also available on the Honeywell 6600 through batch job entry at DSC.

b. Other Federal Agencies:

(1) The Solar Energy Research Institute at Golden, Colorado, offers the APEX III linear programming system on its Cyber Computer.

(2) The USDA Economics Research Service has access to the APEX III linear programming system through use of the Colorado State University Cyber Computer at Fort Collins, Colorado.

c. Other:

(1) Commercial accounts can be obtained at Colorado State University in Fort Collins, Colorado, to use the APEX III linear programming system on the Cyber Computer.

(2) The AGNET System (which provides linear programming capability) is available at county extension offices throughout Wyoming.

4. APPLICABILITY:

a. Provides assistance with ranch budget analysis for grazing environmental impact statements.

(1) Can be used to obtain the competitive market value of BLM forage.

(2) Determines the impacts of forage reallocation.

b. Assists in Benefit/Cost Analyses

c. Linear programming can act as a planning guide to maximize multiple resource use.

d. Has applications to guide in minimizing community impacts of future energy development.

5. WHERE OR HOW TECHNIQUES HAVE BEEN USED:

a. Linear programming techniques have been used extensively in grazing environmental impact statements to determine the effects of BLM forage reductions on the livestock industry.

b. The Forest Service has used linear programming to determine the demand for Forest Service forage in Colorado.

6. SOURCE/CONTACTS:

a. Bureau of Land Management:

(1) For training on the use of the MPS linear programming package, contact Fred Martinson at the Denver Federal Center. MPS offers continuous solution, integer and binary programming options.

(2) For consultation and documentation on small continuous solution linear programs, contact John Young at the Rock Springs District BLM Office.

b. Textbooks on Linear Programming Techniques:

(1) Kuester, J.L., and J.H. Mize, 1973.
Optimization Techniques with FORTRAN.
New York: McGraw-Hill Book Company.

(2) Wagner, H.M., 1975.
Principles of Operations Research, Second Edition.
Englewood Cliffs, New Jersey. Prentice-Hall, Inc.

1. NAME: Farm Budget Model

2. DESCRIPTION

a. General Description

This is an interactive computer model for calculating farm budgets. It is easy to use and capable of handling a wide range of crops and farming situations. The major limitation is that the data sets are for Idaho, Idaho counties, or regions within Idaho. Basic data requirements are items such as crops to be grown, county that the farm is located in, soil types, interest rates, farmable acreage, etc.

3. ACCESSIBILITY

The farm budget model is located on the Idaho Department of Water Resources computer. Use is limited to one hour a week unless special arrangements are made in advance.

4. APPLICABILITY

The model's primary use is to analyze economic feasibility of desert land act applications.

5. EXAMPLE OF WHERE OR HOW TECHNIQUES HAVE BEEN USED

The model is being used in Idaho to analyze DLE's. Sample outputs can be received by contacting the Idaho State Office.

6. SOURCE/CONTACT

A user's manual is available on the use of this model. Primary contact is Stanley C. Frazier, Agricultural Economist, Idaho State Office.

I. Name: Petroleum Activity and Decision Simulation (PADS)

II. Description:

A. General

Oil and gas exploration, development, production and transportation are highly complex and interdependent activities. Given the petroleum resource base of an area, the interaction of public policies with prices and costs affecting these activities determines the economic value of oil and gas located within that area.

This technique uses a petroleum activity and decision simulation (PADS) to probabilistically model the major activities involved in oil and gas exploration, development, production and transportation under conditions of uncertainty. The model simulates oil and gas activities for an extended period of time (e.g., 40 years), with the activities in each year dependent on the simulated results in previous years. This year-by-year simulation represents one pass of the model. A large number of passes are run and their results aggregated as frequency distributions to evaluate a policy option.

Some of the major uncertainties affecting oil and gas activities are incorporated into PADS directly through the use of probability distributions and a statistical sampling process. For each pass, a randomly selected combination of the uncertain components including both the oil and gas resource base in the area and costs is selected to simulate one possible state under which oil and gas activities might occur. The economic consequences of the selected combination are evaluated for each pass. At the end of the model run, the range of these economic consequences over all the passes is presented as a probability distribution.

The area's surface is arbitrarily partitioned into activity areas which serve as the basic geographic units for analyzing petroleum or other land-use activities and constitute the lowest level of geographic detail in PADS. The size, shape, number, land use classification, transportation corridors, and the timing, rate and sequence of such activity areas may be changed in an analysis of alternative policies. For example, the study area may be divided into two sets of activity areas, one set closed to petroleum activity and the other representing areas that could be opened for petroleum activity according to a particular schedule. The economic consequences of such an areal designation may then be tested.

The PADS model simulates a sequence of decisions regarding potential oil and gas activity over an extended period of time given the presence of uncertainty about the petroleum resource base. Decisionmaking is simulated explicitly - choices are determined within the model according to an economic decision rule and are not provided as inputs to the model. The major decisions treated in this manner are the decision to test petroleum prospects with an exploratory well, the decision to develop, produce and transport the oil or gas in a discovered reservoir, and the decision to abandon a producing pool. For these decisions, the model explicitly differentiates between prior expectations and ex post outcomes.

The PADS model is composed of an integrated set of process-oriented submodels. Each of the major elements of petroleum activity is repre-

sented in a detailed submodel that attempts to capture the major characteristics of the particular process. The submodels are:

1. Geology. The geology submodel simulates a particular resource base for each pass of the model.
2. Exploration. The exploration submodel simulates the search for oil and gas in a frontier basin.
3. Development and Production. The production submodel simulates the development and production of oil and gas discoveries.
4. Study Area Transportation. The study area transportation submodel simulates the development of pipeline networks for moving oil and gas to a point of exit.
5. Corridor Transportation. The corridor transportation submodel simulates pipeline and marine systems for moving oil and gas from the study area to market.
6. Economic. The economic submodel interacts with Submodels 2 through 5 to estimate the major economic implications of petroleum activity in the study area.

Figure 1 presents a logic diagram of PADS.

B. Strengths

PADS provides geologic information in a format that permits economic and policy analyses. It explicitly recognizes uncertainty in the values of inputs and outputs. Because it is a process simulation, any aspect of the process which is modeled can be analyzed. It is much less time consuming and expensive than tract evaluation techniques.

C. Limitations

As presently configured, PADS requires a large CDC computer and fairly detailed cost data for exploration, development, production and tranportation in the study area.

D. Data Requirements

PADS requires probabilistic geologic data, costs and prices for oil and gas exploration, development, production and transportation, and policy inputs such as type of leasing, boundaries of activity areas, timing of development, and transportation corridors.

E. Accessibility

PADS is available to the general public. It is currently formulated to run on a CDC 175 under the NOS operating system. It is written in structured FORTRAN IV which uses several CDC FORTRAN extensions.

F. Applicability

PADS was developed to perform economic and policy analyses of an onshore frontier petroleum basin, specifically the National Petroleum Reserve in Alaska (NPRA) on Alaska's North Slope. With only minor modifications, it can be used for other North Slope analyses. For other frontier petroleum applications, appropriate modifications to the data base, particularly

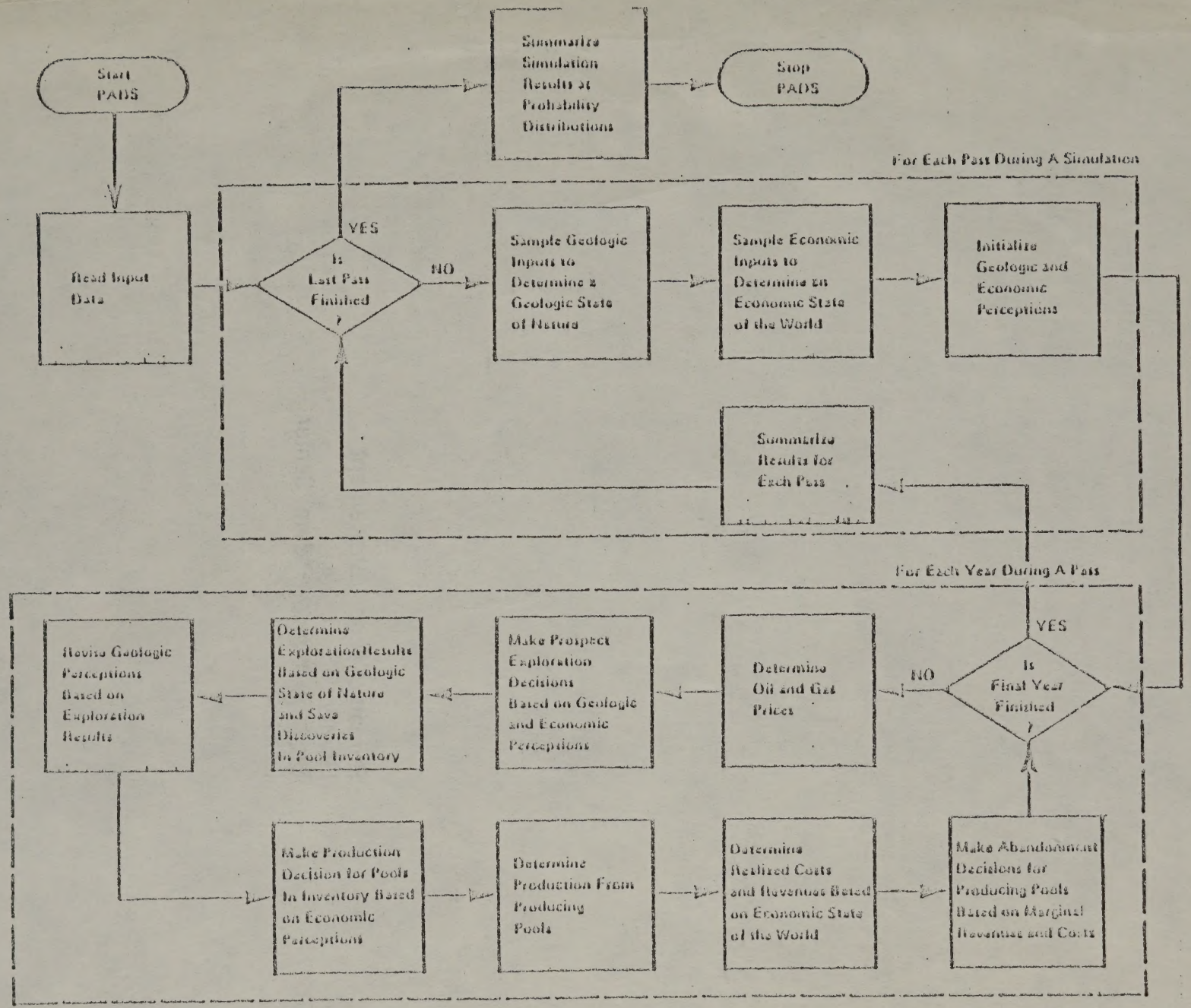
Start PADS
Summarize Simulation Results as Probability Distributions
Stop PADS
For Each Pass During A Simulation
Read Input Data
Is Last Pass Finished ?
YES
NO
Sample Geologic Inputs to Determine a Geologic State of Nature
Sample Economic Inputs to Determine an Economic State of the World
Initialize Geologic and Economic Perceptions
Summarize Results for Each Pass
For Each Year During A Pass
Revise Geologic Perceptions Based on Exploration Results
Determine Exploration Results Based on Geologic State of Nature and Save Discoveries in Pool Inventory
Make Prospect Exploration Decisions Based on Geologic and Economic Perceptions
Determine Oil and Gas Prices
Is Final Year Finished ?
YES
NO
Make Production Decision for Pools in Inventory Based on Economic Perceptions
Determine Production From Producing Pools
Determine Realized Costs and Revenues Based on Economic State of the World
Make Abandonment Decisions for Producing Pools Based on Marginal Revenues and Costs

Figure 1 Petroleum Activity and Decision Simulation

the geologic and cost data, would be required. Relatively minor modifications would be needed to apply PADS to frontier portions of the Outer Continental Shelf, particularly those off the Alaska coast. Further modifications would be required to apply it to more mature petroleum basins. The feasibility of applying this methodology to other minerals including hardrock and bedded deposits is being actively pursued.

G. Examples of Use

PADS was used to produce the Presidential Report on NPRA, the NPRA bill development, the Arctic National Wildlife Refuge resource evaluation, updates of the NPRA analysis, and the Regulatory Impact Analysis for the NPRA lease sale. The Canadian Department of Energy, Mines and Resources has adopted PADS and modified it for the Canadian environment for use in planning lease sales. The State of Alaska's Department of Natural Resources has proposed using PADS for its land use analyses. Several petroleum firms have obtained copies of PADS for use in strategic planning of petroleum basin development.

H. Source/Contacts

Draft documentation of PADS is available from the Office of Minerals Policy Analysis, Bureau of Mines. The contact people are Paul Bugg (343-8714) or Red White (343-8797).

Bureau of Land Management
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